UAS Tech. Series *No. 47*

AGRARIAN STRUCTURE AND STRATEGIES FOR AGRICULTURAL DEVELOPMENT FOR THE 21st CENTURY

Volume III

1987

UNIVERSITY OF AGRICULTURAL SCIENCES
BANGALORE

UAS Tech. Series *No. 47*

AGRARIAN STRUCTURE AND STRATEGIES FOR AGRICULTURAL DEVELOPMENT FOR THE 21st CENTURY

(Proceedings of the National Seminar held at UAS, Hebbal, Bangalore from 3rd to 5th December, 1985)

Volume III

1987

UNIVERSITY OF AGRICULTURAL SCIENCES
BANGALORE

RESEARCH AND DEVELOPMENT PLANNING

K. KRISHNAMURTHY and K. R. KULKARNI

Development planning has to take into consideration ways and means of mobilising resources, technical knowhow and management to achieve the goals. Research is to be directed to more efficient use of resources by developing appropriate technologies.

The research programmes can be of short term to reach immediately the goals and also of a long range nature for solving problems which are likely to arise in the near future, because of changing environment due to development. If we have to plan research for 21st century, our requirements for 21st century should be known. While there are no reliable estimates of our requirements for 21st century *e. g.* 2050 AD; the National Commission on Agriculture has given the projected demands of agricultural products by 2000 A. D.

Some of the important development and research priorities are given below :

I. Agricultural Prodcution

A. IRRIGATED FARMING

i. Development emphasis

a. Protection of catchment to avoid silting.
b. Lining of all main canals, distributories and field channels.
c. Drainage of irrigated lands.
d. Land development for irrigation.
e. Regulation of cropping pattern.
f. Infrastructure for supply of water on a volumetric basis.

ii. Research priorities

a. Developing economic methods of canal lining.
b. Developing information on drainage systems suited to different types or soils, and crop pattern.
c. Developing suitable cropping patterns.
d. Developing new crops and varieties suited to irrigation constraints.
e. Cropping patterns with conjunctive use of irrigation water, rainfall and underground waters.
f. Drip and sprinkler irrigation systems.
g. Operational and adaptive research.

B. RAINFED FARMING

i. Development emphasis

a. Soil conservation - more reliance on agronomic methods and permanent development of land.
b. Water conservation systems consistent with rainfall pattern and land use capabilities.
c. Harnessing run off water.

ii. Research priorities

a. Development of appropriate cropping systems.
b. Developing Agri-silvi-horti pastoral systems.

C. INPUTS MANAGEMENT

i. Development emphasis

a. Fertilizer and pesticides production to keep pace with the demands.
b. Infrastructure for fertilizer distribution
c. Development of town composts, sewerage.
d. Large scale production of biogas.
e. Use of bio-fertilizers.

ii. Research priorities

a. Development integrated nutrient supply systems for crops and cropping pattern.
b. Increasing fertilizer use efficiency.

c. Developing new and more efficient fertilizers.
d. Micro nutrients research.
e. Research on micro organism for nutrient synthesis and release.
f. Intensification of studies related to soil physical conditions, its relation to fertilizer responses.

D. CROP PRODUCTION STRATEGIES

i. Development emphasis

a. Establishing agro-based industries.
b. Industries for processing of agricultural by-products.
c. Infrastructure on storage and housing.
d. Procurement policies, stocks build up and remunerative pricing.

ii. Research priorities

a. Research on diversifying the rice production areas.
b. Concentrating the most efficient areas for production of wheat, cotton and sugarcane/diversifying the low productivity areas for alternate crops.
c. Continued research on crop improvements to develop plant types to agro-ecological situations.
d. Research on improving nutritional quality of crops.
e. Developing better crop production techniques, with particular reference to coarse grains and pulses.

E. HORTICULTURE

i. Development emphasis

a. Establishment of agro-industries for processing, storing and packaging.
b. Development for markets within and outside the country.
c. Encourage large scale plantation.

ii. Research priorities :

a. Developing superior plant types.
b. Developing horticultural systems for dry lands.

c. Intercropping systems.
d. Management practices for high yields.
e. Research on under utilised plants and medicinal plants.
f. Research on pollution control.

F. FORESTRY

i. Development emphasis

Large scale afforestation with suitable species as per the land topographics.

ii. Research priorities

a. Studies on trees of economic importance, their growth rates, appropriate methods of propogation and management.
b. Adaptability studies of tree species to different agro-climatic regions, both rainfed and irrigated conditions.
c. Studies on forest trees with mixed cropping of fruit plantation and forage crops.

G. SERICULTURE

i. Development emphasis

a. Development plans are much ahead of research support.
b. The silk industry has to be developed on commecial lines to lead the world in production of silk.
c. Supply of pure seed material.

ii. Research priorities

a. Research on plant material, varieties, agro-techniques for production of mulberry and other plants for worm rearing.
b. Research on techniques of silkworm rearing consistent with rural resources.
c. Disease and pest control.
d. Processing of silkworm cocoons and cloth production.

H. AGRICULTURAL ENGINEERING

i. Development emphasis

a. Large scale introduction of non-traditional forms of energy for agriculture *e.g.* solar energy, biogas, wind.
b. Introduction of farm machinery in agricultural operations to save drudgery and labour.
c. Introduction of sprinkler and drip irrigation techniques

ii. Research emphasis

a. Post harvest technology for field, plantation, horticulture, forestry and medicinal plants.
b. Research on economic ways of utilising alternate energy sources in agriculture.
c. Fabrications of suitable machinery, new irrigation techniques, drainage systems etc.

I.1 Animal Science

I. FISHERIES

i. Development emphasis

Marine, riverine and other water sources should be fully exploited for fish production.

ii. Research priorities

a. Scientific methods of mixed culture feeding and production in different types of water bodies.
b. Methods of development of water bodies for fish production.
c. Fish processing and storage.

2. Dairy :

i. Development emphasis

a. Large scale programmes for upgradition of indigenous herds by breeding.
b. Introduction of exotic breeds where feasible.
c. Large scale fodder development programmes.
d. Liberal health coverage and veterinary aid.
e. Systematic marketing of milk and dairy products.

ii. Research priorities

a. Better management practices - housing, feeding and care, development of economical practices.
b. Research on feeds and nutrition, developing low cost feeding schedules.
c. Research on disease and their control.
d. Research on grass land development, regulated ley farming.
e. Research on milk and milk products.

3. Poultry

i. Development emphasis

a. Encouraging large scale production of poultry for egg and meat.
b. Development of systematic market for poultry products.

ii. Research priorities

a. Development of cheap and nutritions feed for poultry, using farm products, by products and wastes.
b. Developing duel purposes breeds.
c. Research on poultry diseases.
d. Management systems with low cost housing and mechanisation.

4. Sheep and goats

i. Development emphasis

Large scale introduction of sheep and goat rearing as a subsidiary occupation along with crop production systems particularly in dry lands.

ii. Research priorities

a. Research on feeds and nutrition.
b. Grass and forage trees/shrubs in dry areas.
c. Stall feeding and management.

J. AGRICULTURAL ECONOMICS

i. Development emphasis

a. Land consolidation and co-operative enterprises.

b. Developing marketing systems advantageous for agricultural products.

ii. Research priorities

a. Developing of scientific basis for farm plans.

b. Market research.

c. Evaluation of development projects and new technologies.

K. SOCIAL SCIENCES

Home Science

i. Development priorities

a. Development of nutritious food and feed products.

ii. Research priorities

Research priorities in home science have been identified and listed (pp 82 & 84) in the proceedings of the seminar on research management, UAS (1985)

L. AGRICULTURAL EXTENSION

Research prioprities

a. Research studies on transfer of technology

b. New methologies of extension suited to the type of teaching material.

c. Special emphasis for study of the problems of small and marginal farmers.

d. Adaptive research filled trials etc.

CHALLENGES ON THE FOOD FRONT DURING THE TWENTY-FIRST CENTURY

K. BALAKRISHNA RAO

Introduction : Almost two decades ago, the Indian agricultural scenario has shown an interesting and pleasant surprise. At the dawn of Independence, the food production level of the country was only about 50 million tonnes. But now, it has touched an all-time high of 150 million tonnes, thanks to the Green Revolution of 1960s. This remarkable achivement has no where been recorded in the history of mankind, and is largely as a result of the new production technologies introduced from time to time. Here, the role of Commercial Banks, Governmental policies, Co-operative Societies and other agencies cannot be belittled. The overall effect is that the agricultural economy has grown from the subsistence level to a viable and buoyant one.

Expansion of population : But complacency and relaxation of relentless efforts to achieve further advancement would be disastrous, for "everything else can wait, but not agriculture", to quote Jawaharlal Nehru.

Until 1960, the world's population increased very gradually to three billion, and within the next 40 years alone, another three billion will be added to this figure. What is distressing is that more than 90 per cent of the increase will occur in the developing nations, where food supplies are already critical and where technology for increased food production is very inadequate.

The Indian scene, too, presents a similar picture to that of the world. Our population, which was 300 million in late 1940s, is now around 740 million. It will be a billion by 2000

A.D. and is likely to stabilise (?) somewhere between 1300 and 1400 million in the first two decades of the next century. In order to feed the galloping population, it is imperative to double or treble the food production over the next three decades.

Problems, liabilities and opportunities : In spite of the glorious improvement in production, our country is deplorably in the bottom group with reference to the yield per hectare of crops like rice, wheat, jowar, maize, pulses, oilseeds, sugarcane, cotton, etc. This is because vast areas under the major crops include marginal lands. Other reasons for the poor productivity include the low use of fertilizers, poor pest management practices and other improved technologies. The highly unfavourable land-labour ratio is also partly responsible for low productivity. Out of 80 million holdings in our country, more than 55 per cent are less than one hectare in size and this percentage is increasing year after year. It is also estimated that the per capita arable land is only one-fiftieth of a hectare, making it difficult to derive the full benefit accruing from the agricultural technology. Moreover, 45 to 60 per cent of the population have relatively low level food consumption in terms of protein-calorie nutrition.

So, it is high time that we evolve a pattern of agricultural growth which would help us to take full advantage of the achievements, be prepared for the worst, and make it yield more income and more jobs, in addition to more food cater future needs.

In our country, there has been a great neglect of soil, as compared to the attention given in other developed countries. While it takes anywhere between 100 and 400 years for the formation of one cm soil in nature, this soil can be lost just in one year due to soil erosion. Out of the 139 million hectares of land under cultivation, nearly 80 million hectares require better deal from the soil convervation point of view.

Manufacturing problems : In a developing country like India, the existing nitrogen gap will increase with added constraints for lack of infrastructural facilities in manufacturing distribution and utilization of chemical fertilizers. The greater problem in future will be the availability of raw materials for fertilizer production. The production of nitrogenous fertilizer however, is an energy intensive process. Natural gas equivalent to approximately 3×10^8 barrels of oil consumed annually for the synthesis of anhydrous ammonia by the Haberes process. Crude oil which is the base for fertilizer will be in serious shortage all over the world. In the area of chemical fixation, a major discovery is yet to be made to minimise the energy requirement of the conventional Haber-Bosch process for the production of ammonia. Hence, continued non-restricted use of fertilizer nitrogen to increase agricultural production is questionable.

Demand and supply targets : It is desirable that this gap is bridged by creating extra capacity than depending upon imports. For the nitrogen scene, a gap of nearly 1.7 million tonnes of nutrients in 1985 is equivalent to nearly nine plants of 90 tonnes per day ammonia and corresponding fertilizer units. By 1990, this rises to eignteen plants. The increase in capacity creation in the past five years has been about 0.5 million tonnes per year. To acheive this capacity, increase up to 1985 will have to be 0.5 million tonnes per year and 0.8 million tonnes per year thereafter. When compared with the previous experience, the targets are quite high and will entail much greater effort than in the past. It is also not advisable to create more and more of fertilizer plants in view of pollution and health hazards they pose.

Inefficient use of nitrogen and losses in the field : The statistics reveals us that we have reached a ratio of 6:2:1 in NPK utilization by 1978-79 from a ratio of 9:2:1 in 1965-66 as against the scientific expectation of a balanced ratio of 4:2:1 for the country as a whole. There is obviously a relative

wastage in the present use of nitrogen fertilizers. Enormous and nonjudicious use of mineral nitrogen sources have posed problems of soil pollution, pest and diseases build up etc. Further inefficient nitrogen cost-benefit ratio is because of various losses. Denitrification losses in the soil have been estimated to be in the order of 215×10^6 tonnes N/year. Volatalisation losses account for at least 5-20 per cent of the fertilizer nitrogen added to the soils. Leaching is another major source of nitrogen loss extending to 20-25 per cent of the fertilizers nitrogen supplied to the cultivated soils especially in rice soils. Techniques to prevent such losses have made little headway among the farmers. This has rendered our agricultural products expensive compared to international market prices.

Alternative sources of nitrogen : Hence, there is a need to search for alternative sources of crop nutrition. Certain questions are to be asked with respect to the nitrogen inputs : Which is more appropriate ? Whether chemical nitrogen or its alternative such as biological nitrogen ? What would be the environmental consequences of such massive costs of energy ? What are the social and economic factors to be considered in utilising these resources etc.

Biological nitrogen fixation comprises the biological processes that lead to the combination of atmospheric nitrogen, to form ammonia. Since times immemorial, biological nitrogen fixation has remained as one of the main nitrogen resource for cultivated plant species in view of the abundance of nitrogen in nature. However, it is a unique process restricted only to certain microorganisms and plant-microbe interactions capable of harnessing atmospheric nitrogen through these biologial processes for the benefit of cultivated plants. Even though, this natural process has been going on since the distant past as a part of the ecological nitrogen cycle, the dependance of fertilizer production on dwindling sources of fossil energy and the prospects of diminished availability of this costly in-

(v) Vast marginal and other potential areas can be brought under cultivation on a massive scale. Here, apart from agricultural crops, horticultural plants, nutritional gardens and even economic forest species can be raised. Mixed farming practices can also be envisaged.

(vi) Other infrastructural facilities such as farm power and machinery, godowns, transport, market yards, etc. are to improve to cater the enlarged sphere of activity.

(vii) Our country has sufficient man power. The educated youth can become technicians, farm managers, field service men or researchers to identify and suggest appropriate technology at the field level to the large farming community. In other words, a well-knit service organisation attending to such needs will surely raise the production level of the country as a whole.

Concluding, the task of meeting the needs of food and agricultural raw material for the coming century is enormous, stupendous and herculian. It would, therefore, be necessary to devise strategies to step up production urgently at all levels and in all possible ways for combating the challenges.

BIOLOGICAL NITROGEN FIXATION AS AN ALTERNATIVE TO MINERAL NITROGEN FOR 21ST CENTURY

K. S. PRAKASH

The explosive growth of world's population in the twentieth century has been supported by the increased input of industrial nitrogenous fertilizer produced by the Haber's process into the world's agricultural soils. However, to support the inescapable geometric progression of the globa humanity prophesied by the Malthusian, theory, the mankind is obliged to double the nitrogen input in to the global agricultural areas. Augmentation of food production in future lies in increasing yield per unit of land which can only be achieved by the cultivation of nutrient responsive high yielding crops. Nitrogen is the first and foremost nutrient for which crops must respond.

Pollution hazards of chemical nitrogen

The projected global demand for chemically fixed nitrogen in the years to come for sustaining the ever-increasing need for agricultural products has already caused worries in the minds of ecologists and environmental pollution specialists. Since, the accumulation of undesirable nitrate in the environment in future years would contribute to eutrophication, infant and animal metheglobenemia and the formation of harmful nitrosamines. The continuous establishment of fertilizer industries would increase the accumulation of industrial effluents hazardous to flora, fauna and human life. In advanced countries, fertilizer nitrogen pollution has been a major concern while, in developing countries such as India, the concern has been that continuous use of fertilizer may endanger the soil structure.

Denudation of forests and vegetation cover, inappropriate tillage and cropping techniques and practices such as shift cultivation are matter a of concern, causing considerable loss of valuable soil through erosion. The annual loss of soil due to erosion is approximately 6,000 million tonnes, and that of plant nutrients such as nitrogen, phosphorus and potash, 2.5, 3.3 and 2.6 million tonnes, respectively. Soil conservation measures including growing grasses, legumes, etc. and construction of contour bunds have to be implemented, not only to prevent such losses, but also to promote better crop growth. We can continue to neglect our soils only at the peril of our future.

Our land has been cultivated over centuries. Its production potential has to be understood and exploited to the maximum. With more area coming under irrigation and with, continuous cultivation of highyielding crop varieties, more attention towards soil pertaining to nutrient availability acidity, salinity, sodicity, water-logging and other parameters influencing soil fertility and productivity is to be bestowed so as to obtain the desired level of crop performance. Assistance of the local Soil Health Centres can be sought in this regard.

The other major liabilities in reaching the targetted crop yields are improper and inefficient use of water and nutrients, inadequate tapping of sunlight (especially in tropics), poor utilisation of bioiogical nitrogen fixation, improper disposal of wastes, lack of understanding of re-cycling processes and poor integration of crop and animal husbandry, on one hand, and terrestrial and aquatic production systems, on the other.

There are other problems too, limiting agricultural production in the tropics including our country. The humid tropical climate is a source of discomfort, encourages pests and diseases, and results in rapid decay and breakdown of tools and equipments, man needs for production. The absence or inadequacy of quality transport to towns and cities from where

fertilizers, pesticides and other inputs are brought, is another factor limiting production. Moreover, the tropical farmer has to be content with less or no capital to clear the land, build farm roads, or improve his farm to make it productive throughout the year.

Other suggestions : Sunlight, soil, water, plants, animals and human beings constitute the basic resources of our agriculture. By harnessing them profitably and judiciously, we have to fight to feed the growing population. The following package of biological components will go a long way in enhancing food production on the condition that the social, economic and political factors are favourable :

(i) The crop varieties having high potential for yield under normal situations as well as for adverse conditions of soil, drought, flood, pest and disease prevalence, etc. for specific locations are to be identified and grown extensively, under several farming systems.

(ii) Irrigation and drainage go together. With increase in area under irrigation, the agricultural output is going to be enhanced. At the same time, judicious use of water by storing them for lean periods is called for to encourage crop intensity/crop rotation and also to take care of soil health.

(iii) The role of inorganic fertilizers, manures, bio-fertilizers and pesticides in boosting production is unquestionable. Manufacture and proper distribution of these inputs have to be stepped up to meet their enhanced demand.

(iv) Soil and crop management aspects are to receive better attention. For example, the salinity or alkalinity status of the soil can determine the likely success of any irrigation project. Nutrient deficiencies, if any, have to be identified and appropriate measures taken. Also, pests such as weeds, insects and diseases have to be controlled.

put for fertilizers production in the 21st century has obviously brought the subject of biological nitrogen fixation to the forefront only recently.

The vital point in front of developing countries is that we must exploit industrial and biological nitrogen fixation more effectively and extensively than in the past. It is evident that economic (energy loss) and environmental considerations strongly favour biologically fixed nitrogen as an alternative source of choice of the future. The case is further strengthened by the fact that the production of cereal crops - the primary world food source, is most dependent upon the addition of fertilizers nitrogen. Biological nitrogen fixation requiring a relatively simple and localised techonlogy and used as largely renewable energy source has an important role to play in the immediate future of the world agricultural economy.

Searches for nitrogen fixing microorganisms and symbiosis for maximising the biological nitrogen fixation and harnessing some exotic legumes for food and fodder purposes are part of the overall efforts to increase food output on a global scale. Unfortunately, symbiotic nitrogen fixation is not without cost. The host plant must provide photosynthetically reduced carbon (photosynthate) to support the N_2 fixing and NH_4^+ assimilatory activities at the site of N_2 fixation. The estimates suggest that from 15-20 per cent of the total assimilatory capacity of a plant may be utilised to sustain the processes of N_2 fixation and NH_4^- assimilation. Most of the plants utilising biological nitrogen in addition to being C_3 plants invest energy on nitrogen fixing processes. This is especially true in the case of leguminous hosts. Hence, the yield levels of these crop species cannot reach those of cereal species. The estimated costs of N_2 fixation in soybeans are contrasted with the theoretical costs in the hypothetical "N_2 fixing" corn plant. Corn would utilize approximately 5 per cent of the total photosnythetic capacity of the plant to fix all the nitrogen required for growth whereas soybeans would utilise

12 per cent because of the higher protein content of the legumes. Assuming that this increased expenditure would be approximately 200 to 250 kg/ha, the prospect of having a N_2 fixing corn plant may be energetically and economically more feasible than N_2 fixation in soybeans.

Keeping in view of these points the following research guidelines have been formulated for the future :

Fundamental research

1. Identification of other nitrogen fixing bio-system for their efficiency in agricultural systems.
2. Intensification of surveys of spontaneous fixation activities of *Rhizobium*, Blue green algae, *Azolla* and *Azotobacter*
3. Isolation, characterisation and authentication of strains of *Rhizobium* and isolates of BGA, *Azolla* and *Azotobacter*.
4. Study of edaphic, biotic and climatological factors affecting fixation by these systems.
5. Screening of effective and compatible strains of these organisms under various agro-ecological conditions.
6. Evolving new strains of microsymbionts and new genotypes of host (macrosymbiont) for efficient biological nitrogen fixation through conventional and genetic engineering techniques.
7. Study of efficiency of various variants of these nitrogen fixers in the presence and absence of mineral nitrogen to examine their complementarity with the latter.
8. Investigations into the compartmental isation of the host genotype for biological nitrogen and mineral nitrogen.
9. Study of energetics of nitrogen fixation and cost-benefit ratios in terms of agronomic yields and soil productivity.

Applied research

1. Inoculation response trials with various crop species and genotypes.
2. Perfecting the inoculation technology.
3. Cheap and convenient mass production techniques.
4. Development of suitable carrier based inoculants for easy storage and distribution.
5. Proper storage methods for longer and effective selflife of the inoculants
6. Compatibility with other inputs and subsequent survival of the inoculum
7. Popularisation to the growers through extension aids, demonstrations etc.

Use of non-conventional techniques in this promising area

Despite its hypothecial nature, possibilities do exist for rendering cereals to fix their own nitrogen from the atmosphere with the aid of 'nif' complex to be transplanted into these crops by genetic engineering techniques through the mediation of *Agrobacterium tumefacians*. Let us hopefully wait for these spectacular achivements.

Ideas from Dr. D. M. NANJUNDAPPA

Assessment of contribution of agriculture to development in comparison with the various inputs including investments on agricultural development. This should answer the question whether agriculture is being squeezed for the sake of development of other sectors or not.

STRATEGY AND PLANNING TO IMPROVE SOME ASPECTS OF SEED TECHNOLOGY

G. N. KULKARNI

In earlier days seed used to be a by-product of a commercial crop. Due to modernisation of Indian agriculture, great emphasis was given to the integrated approach to crop production emphasising more on the quality of the seed. Hence, there is a necessity of seed multiplication in scientific and systematic way. This is one input which can be produced with local resources which will create tremendous opportunities for employment.

Brief history of the development of seed industry

In the past, seed problems were analysed and suitable recommendations were made by Royal Commission Agriculture (1926), Famine Enquiry Commission (1944), Grow More Food Enquiry Committee (1952), Agriculture Production Team (1959), Programme Evaluation Organisation (1960), Seed Multiplication Team Review (1961), Seed Review Team (1967) and National Commission on Agriculture (1971). As a result of these recommendations, several developments have taken place in the seed industry of the country. There are now 13 State Seed Corporations, 16 Seed Certification Agencies and 55 Seed Testing Laboratories located in different parts of the country. The planners, scientists and administrators should take into consideration the magnitude of seed industry by 2000 A. D. as given by the National Commission on Auriculture (1976) in establishing 70 breeder seed organisation, 75 foundation seed agencies, 360 certified seed agencies, 3000 processing units and equal number of seed stores. As a step formed in achieving these objectives National Seed Project has been started in the country with the

financial assistance of the World Bank. Now it has helped in organising 33 breeders seed units, 24 foundation seed production units and 14 seed technology research centres with modern equipments and facilities for production, processing, storage, research on various aspects of seed technology.

Strategies in seed technology

Different areas of seed technology at present are handled by the available manpower as qualified seed technologists are not available. In order to have proper qualified persons in required number it is essential that all Agricultural Universities in the country should have courses at undergraduate and post-graduate level in Seed Technology. At present this facility is created only in few Universities. National Commission on Agriculture has envisaged the requirement of 10,000 graduates and post-graduates to handle the seed industry of the country by 2000 A.D. such qualified persons are also required by the Private Seed Industry which has enlarged over last fifteen years. It is estimated that about 500 seed companies are doing business in India.

Seed Production

As far as possible seed production should be concentrated in suitable agro-climatic regions to increase production per unit area in order to bring down the cost of the seed. For a successful seed production programmee irrigation facilities are needed which is difficult to make available to one and all seed growers. To overcome this, it is better to concentrate efforts on seed production research in rainy season and evolve suitable technology to overcome the factors affecting the season. It is essential to undertake agronomic investigations to evolve package of practices for seed production in various crops. We should also try to concentrate our efforts in increasing the seed production by the application of hormones and growth regulators and micronutrients which have indicated 20 per cent increased production in case of pulses and oilseeds in recently conducted sporadic tests.

Breeder seed which is basis for further multiplication, suffers in quality and quantity. In some cases it is learnt that the incenting organisations do not lift at all the breeder seed which is produced with all the care and strict supervision, spending valuable resources. Every effort may be made to identify seed organisation in all the States and haul up the erring ones. Breeder's job should be restricted to breeding work and the production of nucleus seed of highest genetic purity which can be passed on to another group of scientists for the production of breeder seed who are specialists in the field of seed production. We have to develop separate infra-structure and establish a Directorate of Seed in all Agricultural Universities which can collaborate and keep constant vigil on the seed requirements of different classes of seed for various varieties of different crops.

Our private seed industry is very small and it must be encourage to make significant contribution in meeting the seed needs both for domestic and export purposes by regulating the quality of the seed as per the Seeds Act since the Government Agency will not be able to meet the entire demand of the seed as the magnitude of our requirement is so large. There may be specialised Seed Production Corporations for vegetable, pulses and oilseeds than enlarging the scope of existing organisations making them too large and unwieldy. Demand forecast and production planning with regard to all classes of seeds has to be done well in advance to avoid acute shortage or wastage of seed. This can be done by proper assessment of the seed needs on national basis by an apex body at the Government level.

The seed production programme will have to be backed by an efficient distribution network of qualiy seed is to be made available to the bulk of the forming community.

Seed storage: Controlled storage facilities for large quantities of seed cannot be made available in this country in near

future due to high cost and lack of knowledge and maintenance. The global energy crisis makes the situation still more gloomy. The seed storage technology of the future would have to depend on easily available sources and less energy consuming methodology. To achieve this, several areas are to be explored like selection of proper locations having natural climatological advantages for better storage of seeds, development of low cost artificial seed drying tools and standardization of easily practicable methods of seed treatment including hydration, dehydration technique. Seed producing agencies should also develop proper storage facilities. If necessary, the Government may construct storage facitlities in suitable places and hire them to the seed agencies.

Seed Certification

There is a need to appoint more seed technologists to commensurate with the production to facilitate timely inspection. It is better to develop seed village concept to overcome isolation difficulties. The technical staff appointed to work in the seed processing units need to be trained by the Agricultural Universities.

All the released varieties should be brought under certification without waiting for the formal notification. This will help a great deal to the farmers as they will be getting the benefit of newly released varieties. The Seed Certification Agency is desired to take up extension work and release literrature to educate the farmers in respect of the provisions of Seeds Act and other related subjects.

Seed Testing

There is a need to expand facilities in STL so as to test the samples and communicate the results in time. At regular intervals the Government should be appraised of the quality of the seed tested. Seed vigour has to be quantified and method may be standardised as germination alone will not give clear

picture about the quality of seed, it is desirable to take up seed health testing. Quick methods of health testing may be developed to be used in the Seed Testing laboratories.

The seed inspectors may be appointed as whole time inspectors at various levels which may go a long way in preventing the sale of poor quality seed. They may conduct drill box survey to assess the quality of the seed with farmer during sowing time.

Research in Seed Science and Technology

There is a need to establish Seed Technology Research Units in different agro-climatic zones so as to develop package of practices not only for seed production but also after the harvest of the seed (post-harvest technology).

THE PAST, PRESENT AND FUTURE TRENDS IN QUALITY SEED PRODUCTION AND DISTRIBUTION

A. BOMME GOWDA and RAME GOWDA

Seed is the most basic and probably the cheapest agricultural input which holds the key to farm productivity and profitability. Quality seeds largely determine the success of modern farming as other management and cultural practices come into play only after the germination and establishment of the seeds and seedlings. A country's advancement on the farm front is gauged by its efficiency in quality seed production and distribution.

In India, the modern seed concept had its origin with the Royal Commission on Agriculture in 1928 which proposed the introduction of improved seeds, their scientific production, testing and large scale distribution. The I FYP laid emphasis on the distribution of improved seeds and the II Plan on setting up of Seed Farms. The III Plan, however, pinpointed the shortcomings in the Seed Industry. In 1961, the FAO celebrated the 'World Seed Year' and India became a member of the International Seed Testing Association (ISTA) also. Hybrids of sorghum (1964) and bajra (1965) also were released subsequently. The Seed Act passed in 1966 set high standards for seeds and regulated the production of hybrids. In the mid-seventies, the National Seed Programme (NSP) was launched with the World Bank assistance. The NSP Phase I began in 1976 at a cost of Rs. 50.51 crores and it ended in 1984. The NSP Phase II costing Rs. 38.91 crores was started in 1979 and terminated in December 1985. Under the NSP, the Seed

Farm Developmental Plans, the Seed Processing Plants and the storage facilities were created at 14 centres of the Agricultural Universities.

The certified seed production which was only 14 lakh quintals in 1979 has swelled to 42 lakh quintals in 1983 registering a 300 per cent increase. The VI Plan target of 54 lakh quintals of seeds has already been exceeded. The NSC produced more than 60 lakh quintals. To day, we produce quality breeder, foundation and certified seeds of more than 230 varieties of 70 important crops. The NSC organises the seed production and distribution of certified seeds of selected crops and varieties to meet the National requirements and also for export (African Nations and West Asia).

Summary

The food production in the country has increased by 200 per cent (from 50 to 150 m. tonnes) during the plan period. The annual growth rate in food grain production which was 0.11 per cent prior to 1947 has averaged roughly to 2.8 per cent annually since 1950. This phenomenal increase both in production and productivity may be attributed to the initiation of several Crop Improvement Projects by the ICAR leading to the release and adoption of hybrids and high yielding varieties in different crops. Concurrently the seed industry concerning seed production, processing, storage and distribution also is fast progressing ever since the beginning of the I FYP. Nonetheless, the seed industry was still in an infant stage up to 1980 in most of the states as the infrastructure like the seed farms, farm structures, threshing yards, drying yards, crop production machinery, vehicles, the seed processing plants, storage facilities etc., were very inadequate. Therefore, the National

Seeds Programme approaches needs to be continued and intensified in all the states to meet the ever growing demand of quality seeds by the Indian farmers.

The following are the recommendations of the NCA on Seed Industry in the country

1. All the infrastructure, very essential for seed production, processing, storage and marketing have to be developed for all districts.
2. Congenial areas for seed production for every crop have to be identified.
3. The coverage with high yielding hybrids/varieties is still very meagre. Therefore, all our efforts have to be made to evolve ideal hybrids/varieties, to produce such seeds and to popularise their spread by all extension agencies.
4. There is a need to increase the production of vegetable seeds, oil seeds and pulses as in cereal crops.
5. A system of Registry of varieties at the National and State level has to be prepared and maintained.
6. Seed Certification and seed processing have to be made compulsory.
7. The rules and procedures provided in the Seed Act have to be very scrupulously followed and implemented by the enforcing authority to ensure seed quality.
8. The establishment of quality control laboratories and strengthening the existing ones is necessary to remove the weakness in Certification Agencies.
9. The network of processing and storage points should be made as wide spread as possible.

10. The storage for Breeder and Foundation Seeds have to be Air-Conditioned and those for certified seeds could be only damp-proof and free from pest attack.

11. All the agencies involved in seed production and distribution have to plan in unison for all the infrastructure.

12. All the private agencies involved in seed production and marketing have to be encouraged.

13. The seed research and production programmes have to be further intensified.

14. Promotional measures like seed crop insurance, free from octroi, and taxes, concessional freight, free storage etc., have to be given to the seed growers.

15. There should be Seed Review Committees at all levels to review all seed matters.

INTRODUCING NUTRITIONAL CONSIDERATIONS INTO AGRICULTURAL AND RURAL DEVELOPMENT PROJECTS

K. SHEELA and M. P. VAIDEHI

The ultimate objective of development must be to bring about sustained improvement in the well-being of the individual. It is essential to bring about a more equitable distribution of income and wealth for promoting both social justice and efficiency of production to raise substantially the level of employment, to achieve a greater degree of income security, to expand and improve facilities for education, health, nutrition, housing and social welfare and to safeguard the environment.

Direct nutrition intervention programmes may be effective in reducing nutritional deficiencies but they are very costly and short term. But a long term self-sustaining solution must be sought through broader development efforts that will eventually reduce and even eliminate the need for direct nutrition intervention programmes. Agriculture and rural development projects and policies offer great opportunities for such long term nutritional improvements.

Introducing nutrition into development projects does not simply mean the addition of special nutrition components to projects which would not otherwise have a direct effect on the consumption of nutrients. In view of the linkages between agricultural research and human nutrition, what can the agricultural research centres do to assure that nutritional goals are considered along with other goals in planning their programmes ? The areas in which nutritional concerns might be incorporated are:

Priorities of crop improvement programmes

In any major international breeding programmes attention must not only be given to the quantity aspects of production, but emphasis should also be given to nutritive value and amino acid balance also contribute to improving the efficiency of utilization of foods. Attention must also be accorded to the selection of genotypes that meet consumer criteria in terms of grain size, colour, texture, milling and cooking characteristics.

The other area of relevance in terms of agricultural programmes is the addition of nutritional considerations in forestry projects. One of the major concerns should be to find out the nutritional value of fruits and vegetables and will have to be introduced in programmes.

Technical characteristics

Research decisions influence the nature of the resultant technology which in turn influences human nutrition in the following ways : (1) The nature of the technology is an important determinant of how much more is produced of a particular commodity and at what cost, (2) The extent to which rural households with the malnourished members gain from new technology and (3) since seasonal and irregular fluctuations in the availability and prices of food and in income contribute significantly to malnutrition in many rural areas, new technology that facilitates reduction of such fluctuations would be preferable from a nutritional point of view and also the interaction between technology characteristics and household decision making and allocation of labour may be an important consideration.

Production systems

From a nutritional perspective the key issue for research on production systems is how existing systems can be changed so that malnourished members of farm

and rural labour households can increase their intakes of dietary elements. The focus should be on an appropriate mix of cash and subsistence crops to meet nutritional needs. Because much malnutrition in rural areas is caused by seasonal fluctuation in food availability and the ability to acquire food, research should focus on reducing such fluctuations through improvements in technology and production system.

Food consumption and food prices

Food consumption by the poor particularly the urban poor is very sensitive to changes in food prices. Expanding food supply at lower unit costs may reduce food prices for the consumer and raise incomes for farmers and agricultural labourers.

Women in food production

Considerations to be focussed in providing women better conditions to work in order to achieve levels of productivity capable of satisfying each persons needs. The Government should identify strategies that would provide women with the necessary skills and appropriate technologies to better participate in subsistence food production and improve their traditional small scale village industries.

Training in nutrition

Consideration of nutrition must enter into projects at the preplanning stage and be made evident in all subsequent phases. One potentially effective way of incorporating nutritional concerns into national agricultural research is through training of staff. Incorporation of issues related to the interaction between human

nutrition and agriculture into their training programmes on production, farming systems, research, management and other appropriate subjects.

In conclusion, incorporating nutritional considerations into agriculture and rural development will not only immediately eliminate the need for direct nutrition intervention programmes but establish a firm background for sound food, agriculture and health policies of the country. Together with a general orientation of economic development strategy towards the eradication of extreme poverty, a nutrition focus of agricultural and rural development may eventually eliminate the need for direct nutrition intervention programmes.

RESEARCH AND DEVELOPMENT STRATEGY FOR EFFECTING THE PRESENTLY NEEDED BREAK THROUGH IN FOOD PRODUCTION IN KARNATAKA

K. A. JALIHAL

There has been a marked increase of food production in Karnataka since the reorganised State came into being in 1956. From 38 lakh tonnes in 1956, the food production reached 73 lakh tonnes in 1977-78. Since then, however, there is almost a stagnation in the food front as revealed in the Karnataka Government's Economic Survey, 1984-85.

Individual analysis of the three important food crops *viz.*, rice, jowar and ragi which together account for 56 per cent of the food crop area and 74 per cent of the total food production will help to understand the problem.

It is seen that the first break through in rice production in Karnataka took place in 1968-69 when there was a sudden jump of 8 lakh tonnes of increased production raising the total production to 20.29 lakh tonnes as againt 12.51 lakhs tonnes of 1967-68 i.e., an increase of 62 per cent in one year. There after almost 10 years, i.e., during 1977-78, the rice production increased by 2.5 lakh tonnes as compared to 1968-69. The increase was 12 per cent for 10 years i.e., 1.2 per cent per year. In the last 7 years since 1977-78 we could say there is almost stagnation as an increase of only 0.79 lakh tonnes in 7 years is seen i.e., only 0.14 per cent per year.

Rice is grown in Karnataka in four distinct zones *viz.*, 1) coastal zone, 2) Hilly zone, 3) Drilled paddy zone and 4) Canal irrigated zone.

It is seen that the rice production in all the four zones has stagnated since 1977-78. Only in the hilly zone, there was slight increase in production, in 1979-80 and 1981-82. It is rather revealing that even in the canal irrigated area also there has been stagnation in the rice production.

The strategies for research and development programmes in rice area for many more years to come should focus attention on the following aspects :

Research

1) Concentrate on developing high yielding varieties for coastal zone, hilly zone and drilled paddy zone, instead of focussing undue attention on development of new high yielding varieties for the canal irrigated areas.

2) Research staff in the coastal zone, hilly zone, and drilled paddy zone are required to be strengthened, since Rice Research Stations in these areas have not been adequately developed so far.

3) More research is required on the use of slow release nitrogenous fertilizers in the heavy rainfall area.

4) Research on the use of bio-fertilizers like Azolla and blue-green algae in rice cultivation in the heavy rainfall areas should be given top priority.

Development

1) Use of lime in heavy rainfall rice areas should be vigorously promoted to increase the per hectare yield with the presently available rice varieties. Intensive soil testing work must, therefore, be taken up to assist in this work.

2) Use of IET-1444 (Rashi) variety requires to be vigorously promoted in the drilled paddy zone of Karnataka.

3) Plant protection measures should be given more attention in the rice extension work in the coastal zone, hilly zone and drilled paddy zone, since for many more years to come, those alone will help in increasing rice yields in these areas.

4) Use of slow release nitrogenous fertilizers should be actively promoted in the coastal/hilly rice zones.

JOWAR

The production of jowar which was 9.50 lakh tonnes in 1955-56 and 12.4 lakh tonnes in 72-73 suddenly shot up to 20.23 lakh tonnes in 73-74. However, since then there has been a rather decrease in jowar production in the State, except in 79-80.

The research and development strategies for increasing jowar production in Karnataka should include the following suggestions :

Research

1) There is a need to develop new hybrids to suit the *Rabi* area as well as the *Kharif* jowar belt in the dry farming area.

2) More focus on agronomic research like paired row cultivation of jowar with pulses should be given to findout better mixed cropping methods in jowar cultivation.

3) Research should also give priority to findout charcoal rot and striga resistant hybrids/varieties of jowar

Development

1) Intensive work on optimum time of planting and promotion of recommended fertilizer use on hybrid jowar cultivation should be taken up in transition belt to increase the per hectare yield of jowar.

2) In *Rabi* jowar areas and in jowar growing pockets in dry farming areas, more efforts should be made to promote improved agronomic practices like optimum time of sowing, fertilizer use and recommended plant population practices rather than emphasising on the hybrids till latter are specially developed for these areas.

3) In the *Rabi* jowar areas and in *Kharif* jowar growing pockets in the dry farming areas, vigorous efforts are needed to popularise dry farming practices on proper land shaping and construction of farm ponds.

RAGI

The area under ragi has not much changed from 1955-56 which has ranged between 9 and 10 lakh ha. The production of ragi had also not shown appreciable increase till 1975-76 when it suddenly showed an increase of 5 lakh tonnes over 1974-75

Since then there has been more or less a plateau in the production of ragi except in 1977-78 and 1978-79 when there was slightly high production.

Some suggestions for research and development in relation to ragi cultivation in Karnataka are given below :

Research

1) Ragi Research in Agricultural Research Station, Chintamani should be strengthened to carry out the suitable agronomic research for ragi cultivation in Kolar district particularly much late sowing in August-September which is common in that area.

2) Research on agronomic practices on Kar Ragi is urgent to cater to the needs of Mysore, Hassan, Shimoga and Chickmagalur districts which contribute more than 20 per cent of ragi area where production is not very high.

3) More research is needed to find out different methods of improved organic matter contents of rock soils in the ragi area which will prevent soil formation as well as encouraging soil moisture conservation.

Development

1) Intensive extension work is urgent on promoting land shaping in the ragi area including the construction of farm ponds with individual farmers.

2) Vigorous efforts are necessary to promote fertilizer use on ragi crop, since it is the most important single factor for increasing ragi production by at least 50 per cent in the State.

3) More efforts are necessary to educate farmers on the use of seed-cum-fertilizer drills for ragi and transplanting ragi in August-September for the late season crop rather than sowing.

4) Intercropping of ragi and redgram with early sowing of ragi in July-August should be encouraged to obtain more production-cum-income from dry land fields.

ENERGY FOR AGRICULTURE IN INDIA — PRESENT STATUS AND FUTURE GOALS

N. L. MAURYA

1. Introduction

India like many other developing countries is faced with shortage of energy in all walks of life, including agriculture. The National Commission on Agriculture (1976) has projected that India has to double the energy input to agriculture during next two decades in order to achieve the target of about 250 million tonnes of food production. The Commission has also pointed out that additional energy will have to be found for 30 million hectares land which will be reclaimed in the course of the next two decades. This paper deals in brief about the present status of energy use in Indian agriculture and the efforts needed to meet the future requirements. The presentation is confined to direct forms of energy only.

2. Present energy position

At present, power available for cultivation including water lifting for irrigation is about 0.54 hp/ha consisting of 12 per cent from human sources, 35 per cent from animals and 53 per cent from electro-mechanical and other sources (Randhawa and Maheshwari, 1982). This is much less than the optimum power requirement of about 1 hp/ha for achieving high yields.

The number of human beings and electro-mechanical units involved in agriculture has continuously increased since 1951, a trend likely to continue during 21st century, particularly for latter one. The number of

animals working in agriculture has also increased over the years, but it is likely to decline by the year 2000 AD and thereafter. The cost analysis shows that the human beings are the costliest source of farm power, followed by animals, power-tillers, tractors, stationery engines and electric motors.

3. Human energy

Human sources engaged in agriculture, comprise of men, women and children, many of whom suffer from malnutrition. On an average, they can produce about 45 watts for continuous work for a period of 8 hours a day, thus producing about 0.36 kwh of energy. At a rate of Rs. 10 as daily wages, it works out to be Rs. 22.77/kwh as against about Re. 0.50/kwh of electric energy. Thus, human beings are a very expensive source of farm energy and it is better to use them to organise, arrange, manage, steer, direct and govern the agricultural operations rather than as a energy source.

4. Animal energy

Animals are the single largest contributors of farm power in India and probably the only source for marginal, small and even medium farmers who account for more than 80 per cent of total agricultural land holdings and 40 per cent of the cultivated area. The country has over 86 million work animals consisting of mainly about 75 million bullocks, 8 million he-buffaloes, and 1 million or horses including ponies and mules, and 1 million each of camels and donkeys. A small number of yaks and elephants are also used as work animals. An exhaustive review by Maurya (1985) brought out many research gaps on utilization of animal energy and suggested intensive research work and creation/strengthening of infrastructures to improve the efficiency of animal use in Indian agriculture.

5. Energy from petroleum oils

Oil engines operated on petroleum products are one of the most important source of energy for agriculture in India. Though the oil engines are reasonably efficient, design improvement to increase fuel efficiency to decrease noise, vibration and pollution, and also to make use of renewable sources to operate them are needed. In addition, training and repair facilities within easy reach have to be created.

6. Electrical energy

Though electrical energy is the most efficient and convenient source of farm power, high transmission losses and voltage fluctuations should be reduced to further improve its utilization.

7. Wind energy

An analysis made by the Central Electricity Authority, New Delhi, has indicated that there is wide scope of using wind energy for irrigation pumping (Patel, 1983). Wind machines of horizontal or vertical axes type in the form of wind mills, wind turbines, wind energy converters, aerogenerators etc., are available (Tewari, 1983). However, wind energy suffers from the limitations that it is site specific and prone to large variations in wind speed.

Though several organisations are involved in R & D activities, much more efforts at Regional level are required to assess and fully exploit the wind energy potential not only for irrigation but also for other farm works. It should be possible to develop a hybrid system comprising of windmills and animal power. Efforts should also be made to set up "wind farms" comprising of clusters of medium and large-wind machines and to integrate wind generated electricity with that generated from other sources.

8. Solar energy

India has abudance of solar energy. The total solar energy received by land mass of India is about 60×10^{13} mwh/yr (Pandya, 1981). The Research and Development efforts on solar energy are being persued by a number of academic institutions, national laboratories and a few industries. They cover a number of application areas such as water heating for different purposes including running of engine, grain drying, refrigeration, cooking, space heating, pumping, power generation, etc. For full exploitation of solar energy, it is suggested to establish solar energy laboratories in different regions of the country with precision instruments, to assess the solar energy potential for the region, to take up basic research including storage of solar energy, to evaluate the appliances and technology already developed before they are released for commercial use and to work with ISI to standardize the solar appliances.

9. Biogas

It is estimated that if the entire dung produced by the animals owned by Indian farmers is used to produce biogas containing 50 per cent methane, the total energy production would amount to 240 mwh/day (Pandya, 1981). At present, there are more than 20 sizes of biogas plant available in the market ranging from 2 m^3 to 250m^3 of floating drum and fixed doam designs using animal dung. Biogas plants are also available which use agricultural waste and other organic materials for production of gas. The gas produced is normally used for cooking, lighting and to some extent for engine operation. Several organisations are engaged in research and promotion of biogas plant in the country. However, much efforts are needed to increase gas production, standardisation and construction of biogas plant using local

materials and skills, and to develop/improve ancillary units like stove, lamps and engines. It should be possible to develop a combination of solar-biogas-wind energy as a suppelment to each other for various uses.

10. Biomass

India annually produces an estimated crop residue of over 200 million tonnes, a part of which is used as animal feed. Remaining residuces are either lost or put to very inefficient use. It is also estimated that 150 million tonnes of wood is used annually in rural India as domestic fuel. Here too, the use efficiency is very low (Pandya 1981, Pathak 1981). It is desirable to take up studies on conversion processes/equipment, energy plantation, development of high efficiency smokeless stoves and engine operation with producer gas. Studies should also be intensified for biomass palletization and producer gas technology based on agricultural residue. Laboratories on regional basis should be established for evaluation and standardization of biomass technology appliances.

REFERENCES

Maurya, N. L., 1985, Status of animal energy research in India. Paper presented at 22nd annual convention of ISAE, held at CIAE, Bhopal, during Oct. 29-31.

Pandya, A. C., 1981, Energy for agriculture in India: Tech. Bull. No. CIAE/81/20. Published by Central Instt. of Agril. Engg. Bhopal.

Patel, B. L., 1983, Wind energy utilization in India - A perspective view AET. 7 (6), : 14-16.

Pathak, B. S., Peter, R. and Pahoja, M. H., 1981, Proceedings of seminar on "Producer gas systems and agricultural application". Publ No. SP-0001/81 Published by Indian Society of Agril. Engrs. New Delhi.

Randhawa, N. S. and Maheshwari, B. C., 1982, Energy Management for Farming Needs Sources and Technology. 5(4) : 94-119.

Tewari, S. K. 1983. A brief background paper on wind energy. Prepared for Advisory Board on Energy, GOI, NAL, Bangalore.

A NEW TECHNIQUE FOR EFFICIENT PROCESSING OF ARECANUT

D. R. PRAFULLACHANDRA

In these days where proper maintenance of ecology is very much desired, enormous forest trees have been out to use as firewood for boiling arecanut, which is indeed a national waste and threat to our environment. Therefore, using copper pot and firewood for boiling arecanut may be taken as the most outdated, laborious, expensive and of undesired process. Besides, it would be very difficult to maintain the quality of the processed product in the old method. With this background, sustained efforts for the past several years were made in order to develop a better boiling process.

Even for drying, invariably the farmers use the natural sun for drying the boiled arecanuts. Invariably during this period there will be early monsoon showers and with the result it would be rather difficult to depend on natural sun for drying. Many an occasion, if arecanut does not get sufficient sun for the first two days after boiling the quality of the produce will suffer so badly that it would fetch nearly less than 40 per cent of the market price. With this, there is also need to develop an efficient drier, which should be simple, less expensive and which consumes no firewood and produce good quality cured nuts. With this background, attempts were also made to design the boiler and drier which is reported in this paper.

This paper refers to my research efforts in minimising demand for firewood, stage by stage from 1970 to this day.

The boiling process

In the old boiling process normally round copper vessels of different sizes depending upon the capacity for boiling the arecanut are used. This takes a period of five hours for boiling and would require five quintals of jungle firewood for every quintal of fresh nut. Iron pots are also used sometimes for boiling but here the arecanut turns black due to chemical reaction. In this method of using round copper vessels, there will be lot of wastage of heat since only about 1/8 part of vessel receives heat.

I started my experiment to conserve the heat in the round copper vessel. The vessel was buried inside the brick work up to the neck and again firewood was used. Here 1/3 portion of the copper pot received the heat and there was no wastage of heat and took two hours. However, the amount of fuel used was reduced to two quintals. The disadvantage was that the firewood had to be split into small pieces to go into the furnace involving labour cost. Thus this method took two hours and two quintals of firewood for boiling one quintal of arecanut.

In the subsequent trial, I tried to change the method radically. Instead of using the round copper vessel, I tried a flat bottomed circular copper pot in order to provide greater area to receive heat. This was kept on open fire. Here it took about two hours to boil one quintal and required two quintals of jungle firewood. As such there was no saving of firewood but firewood was not made into small pieces as in second method. Subsequently, even this method was modified. In this fourth method, a circular pot provided with the tight lid like the pressure cooker made out of iron but galvanised inside was used. This method took 40 minutes

and 75 kgs of firewood. Though it was relatively better than the earlier process, the only difficulty was with the labourers who had to operate. The right stage of boiling was to be made known every time releasing the pressure and labourers could not handle this method efficiently. Therefore, this method was again further improvised.

Subsequently, the copper circular vessel was redesigned providing the chimney in the centre of the vessel and covering with the ordinary lid. This method measured 3½' diameter and 18" height. Besides, the lid provided could be easily opened to judge the state of boiling. This vessel was placed over a brick work for boiling and the entire bottom would get the heat. The furnace is also so designed in a circular wag and with a feeding space so that heat is not lost. Here it was planned to avoid using firewood. Instead dried arecanut leaves were used. Here it took 1 hour 25 minutes and 30 dry leaves to boil one quintal of fresh nuts. The 30 dry arecanut leaves used for boiling weighed 20 kg only as against 5 qtl. of jungle wood in the old copper pot method. Above all, this method provides a greater scope to build up our much deared forests from being denuded. Besides, it also adds to the careful maintenance of cleanliness in the garden and conservation of the wastes for purposeful uses.

Improvisation over circular copper vessel is a new 3' x 4' square flat copper vessel with the chimney fixed at the rear side. This system avoids the possible leakage in the chimney—as it may happen in circular vessel. Yet another advantage of the square vessel is the same can be lifted from the oven as and when required without effecting the chimney.

The highlight of the square flat vessel is that three quintals of fresh areca can be boiled with only 80 dry leaves within two hours. This is an all time record in areca boiling system anywhere in the country. The square flat vessel saves time, energy, labour and ensures quality boiling with perfect colouring process.

A national character

Karnataka was only quoted here as an example for cutting jungle for firewood. All the same such a procedure of using jungle firewood for arecanut processing is equally prevalent in all parts of Assam, Meghalaya, Tamil Nadu, West Bengal, Kerala, Maharashtra, Goa-Diu-Daman and Andhra Pradesh. Karnataka and Kerala which enjoy good forest facility equally contribute around 30 per cent each for the overall production of arecanut in the country. That means if only this method is adopted in these two states alone to commence with, enormous forest wealth could be saved. Above all, this method does not require investment and it has no design complication. This circular copper lot at the time would cost around 900 to 1000 rupees. This method was innovated in early part of 1972 and in August 1973 issue of Intensive Agriculture, after series of testing this method was preliminarily made known and all these years it has been further perfected and practiced.

The drying process

After boiling arecanut, the next hurdle faced is that of effective drying in a shorter period of time at lesser cost. It was already indicated earlier that if the boiled nuts are not dried properly within first two days, the quality suffers a lot and fetches only 40 per cent of the regular market value. An innovative drier of boiled or green arecanut was developed. This is of the size of 8' x 3' and placed over a masonry hallow basement. This oven can dry 100 kg of boiled arecanut at a time and it takes seven hours for good drying. The masonry basement if of 2' height and of the size of the drier which is hallow inside and provided with an opening for feeding the fire. On this masonry compartment first cast iron plates of the same dimension of an inch thickness is placed to receive the heat. On this iron plate the chamber oven is placed. The oven has 10 compartments and could be closed with the lid on all sides except the top. Through this top spent air escapes. On these compartments the boiled arecanut is evenly distri-

buted for drying. At regular intervals the position of these trays with arecanut will have to be changed every 15 minutes for uniform drying. Such driers could be arranged in long runs, side by side and the fire fed from both sides. This system of drying along with material and erection would cost around Rs. 2500. This is a permanent investment that could be used for drying not only arecanut but even cardamom, pepper and any other plantation commodity. Earlier risk of spoilage in quality due to cloudy and rainy conditions is avoided. Only dried arecanut leaves could be used for drying at the rare of 60 to 70 leaves for every 100 kg of dried arecanut.

Adoption of both these innovative methods of boiling and drying would involve using only one dried leaf for a plant for processing the produce from that plant.

Merciless burning or rich forest

Annually in Karnataka nearly 57,000 tons of dried arecanut is produced in nearly 39,000 hectares. Normally, 100 kg of fresh arecanut will provide 30 kg of dried nut. At this proportion it comes to production of 13,300 tons of fresh nuts. Each 100 kg of fresh nut would require 500 kg of jungle firewood for boiling. At this rate it amounts to 66,500 acres of forest being annually denuded for boiling arecanut, which is an enormous national waste besides, a threat to our environment. With this innovative method of using circular copper vessel with the lid and control chimney would conserve all these forest area, and no extra firewood is needed at all by careful conservation of the fallen leaves in ones own garden.

Annually each plant will drop 5 to 6 leaves and each plant would provide 3 kg of fresh arecanut. Out of the fallen 6 leaves, only one dried leave would be sufficient in this innovative method to boil the fresh nut obtained from a tree. The remaining 5 leaves could be very well utilised for drying arecanut in rainy season for this thing and other useful purposes. It is also noted that the nuts boiled under this system provided better cured dried nuts.

APPLICATIONS OF BIOTECHNOLOGY IN FISHERY SCIENCE

I. KARUNASAGAR

The use of biotechnology in the manufacture of food and beverages has been practiced for more than 8000 years, but the issue today is the impact of recent developments in molecular biology, fermentation science, tissue culture systems and bioengineering that offer great potential for application in several areas during the turn of this century.

Transgenic goose that lays golden eggs: In 1982 Palmiter's group in Washington, Seattle reported success of producing a "Super mouse". They fused a DNA fragment containing the promoter of mouse metallothionin - I gene to the structural gene of rat growth hormone and this fusion gene was micro-injected into pronucli of fertilised mouse eggs which were then inserted into reproductive tracts of foster mothers. The product of mouse metallothionin I gene is a small cysteine rich peptide that is thought to be involved in zinc homeostatis and transcription of this gene is inducible by heavy metals. Thus Palmiter's group fed transgenic mice with a diet containing zinc and observed growth hormone levels as much as 800 times the normal mice and a corresponding increase in weight. Already this technology has been extended to produce transgenic rabbits, sheep and pigs (Emtage, 1985).

There is a potential to exploit this technology in fish culture. Already attempts are on to clone the genes that code for growth accelerating hormones from molluscs. (Colwell, 1984).

Species identification and stock assessment: Several investigators are exploring the possibility of mapping the mitochondrial DNA (mt DNA) of fishes with a view of using

this to analyse their population structure. mt DNA is digested using restriction endonucleases and the number and size of fragments are compared with those of others in a pattern analysis. Genetic differences among fish species have already been successfully detected by analysing proteins in tissue extracts and the technique that holds promise for future is genetic marking by mt DNA pattern analysis. Introduction of specific genetic traits into fish as opposed to mechanical tags in fish migration studies is another exciting possibility.

Vaccine development : Vaccination of fish against diseases is already being practiced in developed countries and Enteric red mouth vaccine, Furunculosis vaccine, Vibriosis vaccine, combined furunculosis vibriosis vaccine are marketed by Aquaculture Vaccine Ltd., Herts, U.K. This area needs considerable attention in our country. Modern techniques of molecular biology have greatly helped the vaccine development programme in human and veterinary medicine. The most glaring examples are foot and mouth disease vaccine and hepatitis vaccine. Attempts are being made to study fish pathogens also by techniques. Temperature sensitive mutants of Infectious Pancreatic Necrosis (IPN) virus have been isolated to provide genetic information and possible sources of attenuated virus strains for use in live vaccines.

In India, we have no information on viral pathogens of fishes. As yet, cell lines from Indian fishes have not been developed on which these viruses could be grown. Development of tissue culture systems from Indian fishes, study of viral pathogens will have to be achieved by the turn of the century so that vaccine development programme could take shape in the 21st century. Bacterial pathogens should also be studied using modern techniques of molecular biology to characterise protective antigens useful in vaccines.

Applications of hybridoma technology : Already there are reports of monoclonal antibodies against *Salmonella* being used for rapid detection of this organism in fishery products.

Since hybridoma technology enables production of large quantity of antibodies in very pure state, the technique will be highly useful in production of diagnostic reagents for fish disease diagnostic programme. By the turn of this century such diagnostic reagents produced by hybridoma technology would be in the market in advanced countries and in India there is a need to develop this capability and perhaps an institute devoted to production of such reagents needs to be set up.

Monoclonal antibodies will also be useful in characterisation of marine toxins. Presently toxins like saxitoxin, tetradotoxin are characterised by bioassays or chemical assays and efforts are on in several laboratories to develop rapid accurate immunological tests. Recently there was a report of using enzyme linked immunosorbant analysis (ELISA) to detect saxitoxin in shellfishes. More such rapid techniques will be developed in future and they may replace to bioassays by the turn of this century.

Industrial chemicals and pharmaceuticals : Sea weeds have found application in human and animal food, in medicine and agriculture and as a source of raw materials for numerous for numerous industries. Applications of genetic modifications in sea weeds to commercial utilisation and culture are being attempted (Cheney, 1983). Protoplast fusion - somatic hybridisation techniques are now being applied to agar producing sea weeds.

A number of pharmacologically important compounds have been found in marine organisms. Cardiotoxic polypeptides from sea anemones, adrenergic compounds from sponge potential antitumour agents from Caribbean gorgonians (Kau and Sinderman, 1978) are notable examples. Depsipeptide isolated from a Caribbean tunicate has been found to inhibit growth of DNA and RNA viruses as well as 21210 murine leukemic cells. Kaul (1981) pointed out that drugs of high pharmacologic activity from nature have in fact been unsu

passed by synthetic compounds. The fact that it has been uneconomical to extract and purify materials from organisms that have to be captured in large quantities from remote corners of the world, coupled with the general lack of knowledge concerning the basic chemistry of many marine natural products has limited these sources for the development of useful drugs (Colwell, 1983). Genetic engineering can change this situation dramatically by revealing the vast and diverse genetic composition of marine life for pharmacological application. Cloning of gene of marine animals has already begun with the cloning and expression of sea urchin histone genes (Kapstein and Fareed, 1979). There is an urgent need to develop strategies for collecting, culturing and screening marine organisms from which bioactive agents can be isolated and characterised. Techniques of molecular genetics are going to play a major role in this direction.

Prevention of biofouling : Fouling of surfaces in marine environment is a costly burden for any operation carried out in or near sea water. Biofouling occurs in progressive steps from the initial primary film to attachment of invertebrate animals capable of boring and digesting the surface. It has been recognised that larvae of invertebrates prefer to settle on surfaces coated with microbial films. Graham *et al.* (1980) have shown that settlement and metamorphosis do not occur in the absence of microbial films in the case of the tube forming polychaete *Janua brasiliensis*. A number of specific substances that induce metamorphosis and settlement in planktonic larvae of benthic invertebrates have been identified (Hadfield, 1978). Presently attempts are being made in a number of laboratories to develop antifouling agents by developing inhibitors that function at molecular level using techniques of genetic engineering and several success stories are expected by the turn of the century.

Pollution control : Pollution of aquatic environment with industrial chemicals, petroleum products and pesticides

is another problem in fisheries management to which biotechnology might offer a solution in the coming years. Using techniques of genetic engineering, the genetic potential of several bacteria to degrade different fractions of oil have been pooled in one bacterium called 'superbug' by Anand Chakrabarty in USA. In 1980, he obtained a patent for this organism. Genetically engineered bacteria capable to degrading PCBs and other pesticides are also being developed and will be ready for field applications by the turn of the century.

Nitrogen fixing cyanobacteria also have potential use in pollution control. Cyanobacteria from both freshwater and marine habitats have been found to metabolise or cometabolise napthalene, biphenyl and their derivatives and toxic substances present in crude oil (Padhy, 1985). Though normally cyanobacteria are not the dominant constituent of phytoplankton in natural ecosystems, mutant strains resistant to chemicals of interest could be developed which could be exploited for breaking down the chemicals in waste water stabilisation ponds that receive industrial influents.

REFERENCES

Cheney, D.P., 1983, Proceedings of the Sea Grant Conference, Massachusetts Institute of Technology, Cambridge.

Colwell, R. R., 1984, The Industrial potential of marine biotechnology. *Oceanus* 27 (1) : 3-12.

Emtage, J. S., 1985, DNA makes protein makes money. *Nature* 317 (6033) : 185-186.

Graham, S., Krichman, D. and Mitchell, R., 1980, Biol. Bull. Woods Hole, Mass 159 : 160.

Hadfield, M. G., 1978, *Settlement and Metamorphosis of marine Invertebrate* larvae. Elsevier, New York.

Kapstein, J. S. and Fareed, G. C., 1979, *J. Supramol. Struct.* 8 : 7.

Kaul, P. N. and Sinderman, C. J., 1978, Eds. *Drugs and Food from the sea, Myth or Reality.* Univ. of Oklahoma Press, Norman.

Kaul, P. N., 1981, Fed. Proc. Fed. Am Soc. Exp. Biol. 40 ; 10.

Padhy, R. N., 1985, *Nature* (Lond.) 317 : 478.

STRATEGY FOR PREVENTION AND ABATEMENT OF AQUATIC POLLUTION

T. R. C. GUPTA, V. HARIHARAN and R. J. KATTI

The problems of aquatic pollution have of late been assuming great dimensions at least in many parts of the globe. While increased use of the hydrosphere for its valuable resources contribute to the bulk of these problems, man's continuous abuse of the environments coupled with fall out from the atmosphere and land drainage are also known to have significant share in aggravating the situation.

At present the underdeveloped and developing nations are at crossroads between the pressing needs for industrial development on one hand and the associated problems of pullution on the other. The policy makers and environmental scientists proclaim equivocally that prevention of pollution or at best its control at an early stage is the right step to tackle the environmental pollution problems. This is the best achieved if pollution expected at a future date is predicted and suitable abatement measures taken well before the stage when remedial measures become futile. It is at this juncture the future strategies for prevention and abatement of aquatic pollution become a necessity.

Causative factors and sources of pollution

Among the several factors, rapid growth of human population, industrialisation, abuse of environmental resources, improved agricultural practice, mining activities and power generation account for the bulk of the problem.

The major sources and categories of pollutants can be grouped under the following :

a. Domestic sewage and agricultural wastes.

b. Detergents.

c. Pesticides.

d. Oil and oil dispersants from tankers, refineries, spills and mining.

e. Other organic wastes.

f. Inorganic wastes.

g. Radioactive materials from fallout, nuclear power plants etc.

h. Waste heat and

i. Solid wastes.

Pollution induced changes in the aquatic environment

Release of waste matter and pollutants into the aquatic environment is known to result in a host of physico-chemical and biological alterations. Biological changes can be at individual level or at community level as for example mass mortality of fishes, depletion of fish food resources etc., with higher levels of toxicants in the effluent or could result in gradual extermination of sensitive or less tolerant species.

The discharge of biodegradable waste into the enclosed water bodies result in complete deoxygenation which account for frequent mortalities of desirable varieties of food fishes. Organic wastes could lead into the death of a particular water body by sedimentation, eutrophication and release of toxic gases. Promotion of growth of hardy tolerant plants and animal species due to eutrophication caused by excessive nutrient discharge cause hardships to higher trophic levels.

Prolonged discharge of sublethal levels of toxic pollutants are responsible for many metabolic and physiological disorders, change in population structure, and/or change in growth, feeding, fecundity, reproduction and larval development of

fishes, crustaceans and molluscs. The receiving waters are made unsuitable for spawners and developmental stages and migration of fishes.

Pollution control measures

Complete protection of environment is possible only by a total recovery of all known toxic substances by pretreatment of the effluents before it is discharged. Biological oxidation of biodegradable materials increase the BOD in the receiving waters. It is necessary to make the effluent free from heavy metals, detergents, toxic substances, harmful bacteria, pathogens, viruses and suspended matter.

The different state and national bodies (ISI, BSI and ISO) enforce regulations with regard to quality of effluent and the receiving waters and are striving to achieve conservation and protection of aquatic environments with the help of appropriate provisions under legislation.

Role of scientific bodies

The major role of scientific bodies is an understanding the nature of changes of a pollutant in the receiving waters on the basis of various environmental parameters. The pollution is complicated because of the complex combination of several pollutants and waste materials causing multiple changes in the receiving waters. The effects of a substance on the target and non target aquatic organism in its different life history stages forms another important aspect. However, to understand the effect of pollutants on the individual and population level, both laboratory experiments and field studies are essential.

Laboratory studies, bioassay and field studies

Well planned, controlled experiments are necessary to understand the stress to which an organism is subjected.

They help in understanding the levels of toxic substances causing mortality of test organisms either singly or in combination. A short term bioassay for 48 or 96 hr is still a better way to give the toxicology of pollutants and to detect hitherto unsuspected contaminants. Combined toxicity studies give an idea of the impact of more than one pollutant and will bring out the synergic and antagonistic behaviour of more than one pollutant (Waldichuk, 1979).

Sublethal studies

It is very essential to guard against the sublethal effects of pollution. Fishes may complete their life cycle apparently in an healthy state except that they fail to reproduce (Waldichuk, 1979), thus a population or a species could be wiped out. In this context it is essential to note that the "write it off" policy adopted with the inland water bodies as regards to loss of fish wealth cannot be adopted in case of marine environments. The causes for the decline of marine fish stocks are many — shift in the population due to migration, natural mortality, fishing mortality and impact of pollution.

The several responses in each of the sublethal effects are physiology, biochemistry or cell structure, behaviour and reproduction. However success in bioassy study is regulated by :

1. Simulation of natural conditions in the laboratory (Aron. 1976) and
2. Selection, acclimation and preparation of test specimens (Aron. 1976; Sprague, 1969);.

In order to facilitate extrapolation of the laboratory findings, it is desirable and necessary to test the data in the field bioassay studies carried out in a larger area and with more number of test specimens (Parsons, 1977; Lee *et al.* 1977 and Reeve *et al.* 1976).

Limitations and voids in the laboratory and field studies

a. Difficulty in segregating the different events responsible for the reduction of fish stocks.

b. Limited information on the individual toxicity studies.

c. Difficulty of simulating ideal natural conditions in the laboratory.

d. Variation of ideal test specimen from one environment to the other and from one region to the other.

e. Difficulties of applying the laboratory results to field situations.

Field studies

General surveillance and critical pathway approaches are two of the important tools on which scientists, administrators and policy makers heavily lean on to understand the problems of environmental pollution. Regular monitoring in addition to providing base line data helps in detecting trends in their changes and to give advance warning. In addition, they are useful in detecting accidental critical events and could be used to find out the effectiveness of existing regulatory provisions (Goldberg, 1976).

Future strategies

Future strategies for abatement of pollution have to be drawn on the basis of our existing knowledge gained on the behaviour of known pollutants in the receiving environments. Important decisions have to be taken keeping in view of the existing gaps in our knowledge on the state of art in treatment of different wastes, recovery of toxic substances etc. A sense of participation amongst policy makers, industrialists, administrators, scientists and the common man coupled with dedication and hard work of scientific investigators and environmentalists are very essential to achieve the goal.

Future needs could be summarised under the following heads :

a. Systematic survey of concentration of organic chemicals in the environments - atmosphere, land, inland waters, oceans and their sediments (Goldberg, 1976).

b. Assessment of the budget of heavy metals and their fluxes in the aquatic environments (Goldberg, 1976).

c. Establishment of shore laboratories to control and regulate pollution and to conduct prepollution studies in the regions selected for receiving effluents.

(They shall be provided with well equipped laboratories to carry out analyses of waste matter, receiving waters, including studies on speciation of heavy metals and pesticides. Well equipped boats and mobile labs, add to the efficacy of the endeavour).

d. Evolving separate standards to :

i. inland brackish and sea water.

ii. flowing and standing waters.

e. Early establishment of an authority to watch regulate and protect river water quality, on the lines of River Authority or River Boards in existence elsewhere.

f. Re-evaluation of the methodology now followed for BOD analyses (incubation for 5 days at 20°C in an BOD incubator).

g. A redesignation of the measuring of "Safe limits" or "Safe levels" taking into consideration the long range of species and hence the composition of the ecosystem.

The authors wish to place on record their profound thanks to Prof. H.P.C. Shetty, Director of Instruction, College of

Fisheries, Mangalore for the interest evinced and guidance during the preparation of this paper.

REFERENCES

Anonymous 1976, *Standard methods for the examination of water and waste water.* APHA, AWWA and WPCF, 14th edition, pp 1183.

Anonymous, 1976, Indian standards for controlling pollution of marine coastal areas Tolerance limits for water quality after receiving discharges. ISNo 7967.

Goldberg, E.B., 1976, *The health of the oceans.* The UNESCO Press, Paris, pp. 172.

Lee, R.F , Takahashi, M., Beers, J. R., Thomas, W.H., Scibert, B.L.R., Koeller R. and Green, D. R. 1977, Controlled ecosystems, their use in the study of the effects of petroleum hydrocarbons on plankton. In *Physiological responses of marine biota to pollutants* (ed. F.I. Vernberg, A. Calabrse, F. P. Thurberg and W. B. Vernberg) New York. Academic Press. 323-342.

Parsons, T. R , 1977, Test tubes in the sea. UNESCO Courier, January 1977. pp. 2.

Reeve, M. R., Grice, G. R., Gibton, V. R., Walter, M. A., Darcey K and Ikeda T. 1976, A controlled environmental pollution experiment (CEPEX) and its usefulness in the study of larger marine zooplankton under toxic stress. In *Effects of pollutants on aquatic organisms* (ed. A. P. M. Lockwood) Cambridge University Press. 145-162.

Sprague, J. B., 1969. Measurement of pollutant toxicity to fish. 1. Bioassay methods for acute toxicity. *Water Research* 3 : 793-821.

Waldichuk, M., 1979, Review of the problems. In. *The assessment of the sublethal effects of pollutants in the sea.* (ed. H.A. Cole) The Royal Society of London. 399 424.

ADOPTION OF ALTERNATE FARMING SYSTEMS IN AQUACULTURE

T. J. VARGHESE and SHANTHARAM BENGRE

Despite the fact that India has 1.6 millon ha of freshwaters and 2.6 million ha of brackishwaters suitable for aquaculture, the present level of utilisation of these resources is only 0.6 million ha and 30,000 ha, respectively. This low level of utilisation is partly because we still depend on the traditional method of pond fish culture system only. Many of the freshwater bodies available in the country are not suitable for the present system of carp culture, because they are either too large or choked with aquatic weeds. These water bodies can be brought under aquaculture only by adopting alternate systems of culture. The marine waters of India are presently exploited only for capture fisheries. Though there are only very few protected bays along the coasts of India, the system of open sea mariculture can be attempted in several locations. In this paper an attempt has been made to highlight some of the highly productive culture systems which can be profitably apopted in India.

Aeration of still water ponds

Increasing stocking density and adding large quantities of fertilisers and feeds are the common methods employed to enhance fish production from still water ponds. The fertilisers added and left over feed, on degradation result in severe depletion of dissolved oxygen of pond water. The excretory products of the densely stocked fish population also add to the problem. Artificial aeration of pond water is the best solution in combating the problem of oxygen depletion and accumulation of toxic fish metabolites in still water

ponds. In addition to raising the dissolved oxygen content of pond water, aeration accelerates the rate of mineralisation of organic matter and helps stripping of some of the toxic gases like hydrogen sulphide, ammonia, etc. from pond water. Aerated ponds under polyculture of common carp, silver carp and tilapia in Israel produced as much as 43 t/ha/year of fish. The production of white catfish in aerated ponds was 101.4 per cent higher than that of unaerated ponds (Loyacano, 1974). Hollerman and Boyd (1980) found that the average yield of channel catfish in aerated ponds was 5307 kg/ha as compared to 1400 kg/ha in unaerated ponds during the growing period from February to October. Experiments conducted at the College of Fisheries, Mangalore by Vijayan (1983) and Patil (1985) revealed that the production from composite carp culture can be significantly ncreased by aerating fish ponds.

Air-breathing fish culture

It is estimated that as much as 0.64 millon ha of freshwater area available in the country are unsuitable for carp culture being choked with aquatic weeds. Due to poor rate of photosynthesis, high content of organic detritus and prevention of dissolution of atmospheric oxygen, the dissolved oxygen content in such water bodies is extremely low. Therefore, these swampy waters are not suitable for carp culture. The species which can thrive well in these waters are the airbreathing fishes. India has a rich fauna of fast-growing air breathing fishes such as *Clarias batrachus, Heteropneustes fossilis, Channa* spp., *Anabas testudineus* etc. Since operation of fishing gears is difficult in weed-infested waters, it is necessary to clear some area of the water body for installing cages or pens for culture of airbreathing fishes. As may as 200 fingerlings of singhi, magur or murrels can be stocked in a cage of 2 x 1 x 1 m size. Magur stocked at 100/m^3 and singhi stocked at 50-75/m^3 gave productions ranging from 9.9 to 12.0 kg/m^3 /year and 2.8-4.8 kg/m^3 /3 months, respectively (Dehadrai *et al.*, 1985).

Cage and pen culture

Culture of fishes in cages and pens is gaining popularity in many countries of the world. In large scale culture operations, the cage or pen material is made of nylon webbing. There are several advantages in this system of culture. The cage or pen can be installed in large sheets of water, such as reservoirs, lakes, seas, etc., where otherwise finfish culture is not possible. When fishes are kept crowded in cages, they burn less energy for movement, leading to increased body growth. The large volume of water passing through cages or pens flushes off the unconsumed food and metabolic wastes facilitating faster growth. Also harvesting of fishes as well as treatment for diseases is easy in cage and pen culture.

Very high rates of production are recorded in cage and pen culture. Yellowtail *[Seriola quinqueradiata]* and red seabream *[Chrysophrys major]* are cultured extensively in cages. installed in costal waters of Japan. Yellowtail production in Japan has increased from 300 t in 1958 to abour 50,000 t in 1983. Yields as high as 280 t/ha/6 months have been recorded (Bardach *et al.*, 1972). The salmon and trout production in Norway has increased from 500 t in 1973 to 5,800 t in 1980, mainly due to the adoption of cage and pen culture system.

Among the freshwater fishes, large-scale culture of the common carp, *Cyprinus carpio,* is conducted in cages installed in lakes and reservoirs in Japan. The rate of production obtained in this case has been reported to be as high as 300 t/ha/5 months. The channel catfish, *Ictalurus punctatus* is used for both cage and pen culture in U.S.

Raft culture of molluscs

Among the various methods of marine aquaculture, off-bottom culture of oysters and mussels on ropes suspended from floating rafts is the most widely practised system in

many countries of the world. Apart from the 3-diamensional growing area when suspended in water column, the unlimited volume of sea water available for filtering their food as well as the protection from siltation and benthic predators make raft culture of oysters and mussels the most productive system of aquaculture. Presently oysters are farmed commercially in Japan, France, Australia, U.S., Yugoslavia, Netherlands and Norway. The species cultured belong to the general of *Ostrea* and *Crassostrea*. Oyster spats settled on collectors [scallop or oyster shells] and grown to 15-20 mm diameter, are strung on galvanised wires and suspended from rafts. In Japan, during the rearing period of 6-8 months, 40-60 kg of oysters per m^2 area of raft are produced.

The countries engaged in mussel culture are the Netherlands, France, Spain, Italy, Yugoslavia, Russia and Philippines. A total quantity of 3,29,500 t of mussels are produced through culture annually in the world. *Mystilus equlis* is the most extensively farmed species. India has developed the technology of mussel culture on ropes recently.

Running water fish culture

The main factor which limits fish production in still-water ponds, is the accumulation of fish metabolites which inhibit fish growth. The easiest way to get rid of this problem is to culture fish in running water. The water which flows through the pond carries away the fish metabolites. In Japan, common carp, trout and ayu (*Plecoglossus altivelis*) are cultured extensively in running water ponds In this system, through the ponds which are relatively small, a constant flow of water is maintained. The rate of common carp production in running water ponds of Japan is 17.3 t/ha/year [Brown, 1983]. The principle behind the raceway system used in U. S. for culture of rainbow trout and channel catfish is the same as the running water fish ponds of Japan. These systems can be adopted in locations where there is unrestricted availability of unpolluted water.

Technology of the alternate fish farming systems mentioned above are quite well developed in countries where they are in practice. By taking up adaptive research, it should be possible to introduce some of these highly productive systems in India. Some of the above systems, such as the mussel and oyster farming, tested in India have already yielded positive results. However, more vigorous efforts are called for in this direction. By adopting some of the alternate aquaculture systems mentioned above, it should be possible to produce enough finfish and shellfish to meet the protein requirement of the country in the 21st century.

REFERENCES

Bardach, J. E., Ryther, J. H. and Mclarney, W. O., 1972 *Aquaculture - The farming and husbandry of freshwater and marine organisms.* John Wiley and Sons, New York.

Brown, E. I., 1983, *World Fish Farming : Cultivation and Economics.* AVI Publishing Co., Inc., Westport, Connecticut. 516 pp.

Dehadrai, P. V., Kamal, M. Y. and Das, R. K., 1985, Package of practices for increasing production of air - breathing fishes. *Aquaculture Extension Manual, New Series No. 3. C.I.F.R.I.* 14 pp.

Hollerman, W. D. and Boyd, C. F., 1980, Nightly aeration to increase production of channel catfish. *Trans. Am. Fish. Soc.*, 109 : 446 - 452

Loyacano, H. A., 1974, Effects of aeration in earthen ponds on water quality and production of white catfish. *Aquaculture*, 3 : 261-271.

Patil, R. L., 1985, Effect of aeration on the growth of carps under polyculture. *M.F.Sc. thesis,* University of Agricultural Sciences, Bangalore.

Vijayan, M. M., 1983 Effect of artificial aeration on the growth and survival of carps. *M.F.Sc. thesis*, University of Agricultural Sciences, Bangalore.

EXTENSION STRATEGY FOR FISHERIES DEVELOPMENT IN 21st CENTURY

S. BENAKAPPA

The Indian population is increasing at high rate and as experts put it, an Australia is being added every year to Indian population. The increase in food producton from the limited land resources is inadequate to meet the increasing demand of the ever exploding Indian population. Harvesting the aquatic food to augment this demand becomes, thus inevitable. In this regard, aquaculture has the potential of producing large quantities of low cost, protein rich fish food.

The country is endowed with a coastline of about 6536 kms with an adjoining exclusive Economic Zone area of 2,013,410 Sq.kms. The fresh water area comprising of ponds, lakes, rivers, reservoirs etc. amounts to about 1.6 million hectares. Apart from this there is 2.0 million hectares of brackish water resources available for fish and prawn culture. The total fish production from all these waters is 2.70 million tonnes of which the marine fish production is 1.7 million tonnes and the inland fish production is 1.0 million tonnes. It is estimated that, by judicious utilisation of the available fresh water resources and exploitation of continental shelf of 4.5 lakh sq.kms, the fish production in India could be raised to about 8.5 million tonnes. (4.5 million tonnes by marine waters and 4.0 million tonnes by fresh water).

It is estimated that present fish production from marine and fresh water is only 2.7 million tonnes against the demand of 10.4 million tonnes. This could be achieved through efficient utilization of available resources in the coming years.

Various new technologies developed in aquaculture, fish handling and processing, and capture fisheries have not been

put into practical application on large scale. Transfer of these technologies would besides maximising the utilization of the available resources, provide more employment opportunities and improve the economic condition of fisher-folk.

Extension is a vital link connecting technological development with production. Lack of proper fisheries extension is said to be responsible for the slow pace of fisheries development in India. Fisheries extension aims at improving the technical skills of fish farmers/fishermen for rational exploitation of the resources.

Constraints in fisheries extension

The main constraints are :

1. Unawareness of technological details
2. Inadequacies of fisheries education
3. Paucity of resources and material
4. Lack of sense of priority
5. Lack of planning

Objectives of fisheries extension

1. To increase the fish production through capture and culture fisheries by applying latest technology,
2. To regulate fishing for optimum exploitation and conservation of fishery resources,
3. To maintain hygienic handling and processing of fish and fishery products from the time of catch till marketing,
4. To eliminate the exploitation of fishermen by middlemen, especialiy in marketing, and
5. To improve the living standard of fishermen who are engaged in fishing and fish culture.

Present status of fisheries extension in India

The effective transfer of technology needs a concerted effort of the concerned departments. New technologies developed at research institutes are to be transferred to the farmers through the following approaches :

1. Issue of extension pamphlets.
2. Organise training for the core personnel, operatives and financiers
3. Maintain advisory service
4. Participate in exhibitions
5. Organise and participate in fish farmers days and meetings with farmers
6. supply of extension materials to appropriate authorities
7. Participate in operation research project programmes
8. Maintain demonstration centres and organise demonstrations.

Besides the Ministry of Agriculture and State Fisheries Departments, Fisheries extension activities are also carried out by Agricultural Universities, Central Institutes, Krishi Vignana Kendra and Trainer's Training Centre, Fish Farmer's Development Agency, Comprehensive Area Development Agency, Intensive Agricultural District Programme (IADP), Intensive Agriculture Area Programme (IAAP), National Agricultural Research Project (NARP), Community Development Block etc.

Extension strategy for fisheries development

The strategies that could be recognised to bring about an effective extension activity include

1. Need to establish fish seed production centres in good number at different districts.

2. Establishment of demonstration fish farms for fish farmers regarding the techniques of seed production and culture up to marketable size.
3. Educational programmes about new technologies developed concerning fish preservation, utilization and nutritional aspects etc.
4. Demonstration on proper application of technology in exploiting reservoirs, tanks, ponds and rivers.
5. Training centres for imparting training programmes.
6. Reclamation of utilizable waters and leasing them to farmers.
7. Granting loans/subsidies/incentives to fish famers/fishermen along with marketing infrastructure.
8. Diversifications of fishing methods for proper exploitation of under utilized Exclusive Economic Zone.
9. Delimiting budgetory provisions towards the infrastructure for fisheries extension.

Extension education efforts both for developing technical and paratechnical personnel with a good infrastructure for extension network should be able to promote the fisheries development raising its production manifold. This is a dire step needed at the face of the present resource potential available (both marine and fresh water) to release the pressure on the limited land resources.

PROGRAMME FOR EFFICIENT EXPLOITATION OF OUR EXCLUSIVE ECONOMIC ZONE

P. K. SALIAN and S. L. SHANBHOGUE

India is bestowed with a long coast line of about 5900 km with the continental shelf area of 4.15 lakh sq.km around it and of this less than 25 per cent is fished now intensively. With the introduction of modern method of mechanised fishing for inshore fishing about 35 years back, our mechanised fleets contribute to about $33^1/_3$ per cent of the total marine landings of the country. At present, our marine catch is about 1.8 million tonnes, whereas the estimated potential sustainable catch is 5.0 million tonnes from the exclusive economic zone (EEZ).

The State of Karnataka stands sixth in the production of marine fisheries with its contribution of 8.0 per cent to the country's total landings. The averge catch being 1,00,000 tonnes which varied from 75,000 to 1,50,000 tonnes per year, when compared with the catch per kilometer, Karnataka is in third position, next only to Kerala and Maharastra.

Resources of EEZ along the Karnataka Coast

Karnataka coast has a coast line of 300 km with an exclusive economic zone of about 87000 sq km. The continental shelf extends over 27000 sq km and harbours rich pelagic and demersal resources. The inshore waters up to about 50 m depth are heavily exploited with the help of about 2050 shrimp trawlers exploiting the demersal resources, 370 purse seines exploiting the pelagic resources, 600 gill netters exploiting the midwater resources and a large number of over 9000 small indigenous crafts. On an average about 1,00,000 tonnes of marine fish valued at about 25 crores are landed annually. The export of seafoods has made much progress and about 4000

tonnes valued about 15 crores are exported from the State each year. The estimated total potential of the EEZ is about 4.25 lakh tonnes.

Important pelagic and columnar resources of Karnataka are following. The Indian mackerel, *Rastrelliger kanagurta* is most improtant since it is highly valuable. The fisheries are subjected to annual and long term fluctuations. Considering the stock levels if the fishery is managed properly average yields of about 40-60 thousand tonnes are possible. The sardine stock consists of several species. Oil sardine, *Sardinella longiceps* is by far the most important, but other lesser sardines also contribute to the fishery. Considering the fluctuations, average yield of about 60 to 80 thousand tonnes of sardines could be expected from this coast. Another important resource which awaits fuller exploitation is that of white-baits. The stock consists *Anchoviella heteroloba, A. batavi-ensis, A. zollingeri* and other stray species. Only a very small fraction of this resource is exploited at persent and there is considerable scope to increase the landings from about 5 to 30 thousand tonnes. Another important resource, the exploitation of which is almost insignificant is tuna which is available in large quantities in offshore waters. This highly valuable resource which has good international market need to be exploited in the near future. Other important resources of the coast are catfish, ribbon fish, horse mackerel and also other miscellaneous species.

In the demersal resources the most valuable item is penaeid prawn. Along the Karnataka coast the density of penaeid prawns decrease from shallow to deeper areas. The maximum concentration of these inshore prawns was around the depth of 20 m. Elasmobranchs are caught in increased quantities with depth and the peak abundance is in the depth range of 40-59 m. The catfish also was available in large quantities in the depth range of 40-59 m. Another important fish, namely pink perch are caught in significant quantities in

the depth of 40-59 m. *Lactarius* on the other hand are caught in appreciable quantities in the depth zone of 20-39 m. Ribbon-fish are also available in large quanitities in the depth zone 20-39 m.

Studies made on the standing stock of demersal resources along the Karnataka coast have revealed that in the depth zone 0-80 m about 32,000 t are available. Fishing has resulted in a return of 7.0 t/sq km for 0-20 m depth belt and 2.9 t/sq m for 20-80 m depth zone with an average value for 0-80 m depth zone being 3.5 t/sq km for demersal resources.

Recent studies (1983-84) on demersal resources carried out by Fishery Survey of India has revealed that along the Karnataka coast pink perch, catfish, lizard fish and carangids are abundant within 200 m depth, while *Centrolophus niger* (black ruff), *Priacanthus* spp. (bulls eye/big eye), *Psenes indicus* (Indian drift fish), deep sea prawns and deep sea lobster formed the bulk of the catch from areas in the zone 200 to 500 m.

Diversification and exploitation

Considering the present state of development, there is no need to increase fishing effort in the inshore zone 0-40 km since the pelagic and demersal resources are fully exploited and the columnar resources will be fully exploited in a couple of years since all attention is now focussed on these. It is time now to plan for exploitation of deep sea and offshore resources of the EEZ. The development and planning of deep sea fishing programme will differ from the initial mechanisation in the important respect that it will not be a socio-economic programme but a programme of commercial developments. The fishing boats constitute a major investment in the country's industry and with mechanised fishing they will probably represent the largest single investment. The diversification of fishing methods and development of deep sea fishing programme depend on several aspects.

There is urgent need to have adequate number of vessels for different methods of fishing in the EEZ like purse seiners, deep sea trawlers, gill netters, long liners, pole and liners, spuid jiggers etc. Some of these vessels could be designed to fish with more than one method. Considering the resources the number of medium and large vessels required are about 200 (12 to 18 m) and 150 (18 to 37 m) respectively. These proposed vessels may require two medium sized fishing harbours to accommodate vessels up to 4.0 m draft and one big fishing harbour with a draft of 6 to 8 m.

Taking into consideration the resources of the EEZ of Karnataka, there is ample scope for diversification and exploitation of these rich resources to meet the ever increasing demand.

RESEARCH STRATEGIES FOR EFFICIENT UTILIZATION OF IRRIGATION WATER IN THE 21ST CENTURY

A.S. PRABHAKAR, C.V. PATIL and M.D. KACHAPUR

Karnataka having geographical area of 19 million hactare provides 11 million ha. of cultivable land of which only 13.4 per cent of the area is under irrigation. The State has total exploitable surface and ground water resources to the tune of 5.4 million hectares which covers only 50 per cent of the total cultivated area. Under the prevailing agroclimatic conditions, scarcity of irrigation water and lack of drainage system, adoption of efficient water management practices is a must, which would help to increase agricultural production besides preventing deterioration of productive soils. The major water management problems of the state may be listed as below :

1. Scarcity of good quality irrigation water.
2. Lack of efficient water distribution technology.
3. Lack of drainage system.
4. Rise of water table and development of soil salinity in canal irrigation areas.
5. The gap between the irrigation potential created and actually irrigated. It is mainly because of delay in land levelling and construction of feeder channels.

Cropping pattern

With the introduction of irrigation, the cropping patterns and the production technology have changed. For example, in Malaprabha Command area about 60 per cent of the irrigated area is occupied by hybrid cotton alone. Such mono-cropping systems are bound to exist in other Command areas due to

wrong pricing policy by the Government. It is very much essential to develop suitable cropping pattern to have 100-300 per cent cropping intensity for different situations. By selecting suitable crops and varieties of crops that can stand less number of irrigations and making necessary adjustments at the time of irrigation, it may be possible to grow more than one crop, particularly under constraints of irrigation. This would help to increase the total production per unit area and also result in increased water use efficiency. For example, if a total of 6 irrigation are available for a crop during *kharif* only 3 or 4 irrigations may be given at the critical stages crop growth during *kharif* and 2-3 irrigations thus saved can be stored in a farm pond and reutilized for growing of crops during *rabi* season. There are, at present, no suitable varieties/hybrids of *rabi* crops which are well suited for multiple cropping and inter cropping systems under irrigation. It is therefore, essential to conduct intensive research on different aspects of crop production, maintenance of soil productivity and increasing water use efficiency.

Agro Forestry System

Introduction of suitable Agro-Forestry system in irrigated areas will go a long way in increasing the total productivity of these areas. In addition, the tree species with deep root system will help in recycling of water and nutrients from deeper layers help in maintenance of good soil health by prevailing rise of water table and improving soil physical conditions through the addition of organic residues.

Land drainage system

In canal irrigated areas where the ground water table has risen to within critical depth from ground surface, the lowering and stabilization of water table below this critical level by installing an appropriate drainage system is a must. Either horizontal drainage or vertical drainage systems are generally

adopted for water table control. The horizontal drainge system may be either deep open drains or sub-surface tile drains whereas, for vertical drainage, shallow tube wells are more effective. In black soils, tile drainage system will be costly and difficult due to closer spacing and greater depth of installation. Alternatively, the vertical drains will be cheap and more effective. If the quality of water from the vertical drain is satisfactory, then it must be used in conjuction with canal water. However, in some situations, where the drainage water is highly saline and no outlet is available for its disposal, vertical drainage is not advisable. Another approach in similar situations to be adopted by state Government would be to install a series of vertical drains and to pump the highly saline water directly into canals so that the resultant EC of mixed water does not exceed 750 micromhos/cm. There is an urgent need to study the feasibility of this approach in a few canal distributories on a pilot basis.

Dual purpose farm ponds for drainage and irrigation

In black soils, during heavy rains water ramains standing on the cropped land due to low infiltration capacity of soil. Stagnation of water is detrimental to many field crops and reduce crops yields. The excess water has to be drained out either through surface or sub-surface drainage systems. However, in the absence of adequate field drains particularly in level terrain where there is no natural outlet, the surface drainage, through dug-out farm ponds may be the only method of land drainage. The characteristics of dual purpose farm ponds are :

i) Allow the water to stand in the cropped land only up to such time as is not harmful to the crops.

ii) drain the excess water from various fields into dug-out farm ponds of sufficient capacity in low-laying areas ; and

iii) reuse the stored water for irrigation as and when required.

Future research priorities

In the coming years, scientific soil and water management in the irrigated areas will hold the key to intensive agriculture and sustained soil productivity. At present, efforts are being made to accomplish horizontal expansion in the irrigated area without much stress on improving the irrigation efficiency, which is the cheapest, quickest and most reliable way of adding to the country's irrigation potential. Efficient utilization would mean that the average yields of crops in irrigated lands will increase that the farmers located in the middle and tail end of the canal system will receive more water than they do today and that the long-term productivity of irrigated land threatned today by increased salinity and water-logging will be preserved. For this purpose the following are the research priorities:

1) The existing pattern of training the staff has to be changed. The current emphasis is on construction and design, rather than on operation and maintenance because it carries better promotion prospects. A separate operation and maintenance cadre consisting of specialists in water distribution technology, Soil and Science, Agronomy, and Agriculture Economic needs to be created.

2) Introduction of warabandi system for equitable distribution of irrigation water to all the beneficieries.

3) The present design criteria are grossly insufficient to take into account the variations in soil characteristics and in water requirement at different stage of plant growth. Hence the basic design philosophy of canal irrigation has to change for greater precision of control over timing and quantity of water delivery.

4) More attention needs to be paid to minor canals and distributories between the main canal and their outlets. These get neglected because of the fascination with large structures.

5) Introdction of canal irrigation invariably leads to water table rise particulary where the natural drainage system does not exist. Therefore, development of integrated irrigation and drainage technology by adcpting conjuctive use of ground water with canal water, installation of technoeconomically feasible drainage system, introduction of fishery in brakish water dugout ponds for salt evaporation high research priorities.

6) To quantify irrigation-fertilizer interaction for different crops and cropping systems under different irrigation and fertilizer levels need to be studied.

7) The response of new crops and varieties under different water management practices and inputs constraints need to be tested.

8) Long-term effects of the use of irrigation water on salt balance, ground water regimes and crops yield has to be studied under different agroclimatic conditions.

9) The existing system of water charges need to be reviewed. No doubt this is a very sensitive issue because of farmer's resistance to the idea of paying more, But with increase in efficiency, it should be possible to create a climate for the recovery of atleast the full cost of irrigation projects.

10) Evaluation and utilization of unconventionale sources of water such as sewage and industrial effluents for irrigation.

11) Diversion of west flowing rivers like Aghanashini, Mahadevi, Netravati etc. which carry 2500 MTC and joining to east flowing rivers in Krishna and Kaveri basin.

BIOTECHNOLOGY AND AGRICULTURAL MICROBIOLOGY

P. V. RAI

Biological technology is a fund of knowledge applied in economically advantageous scientific discoveries like industrial production. Bull defined biote chnology as application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services. This technology has a great potentiality in the field of medicine, agriculture and industry. For example the genetic regulator of insulin biosynthesis was introduced to diabetic patients through a mediator, *E. Coli*. Genetic engineering and tissue culture are the two techniques found in the forefront of biotechnological research at present. However it includes fermentation technology, single cell protein culturing, regulation of biological nitrogen fixation; production of biofuels, antibiotics, microbial insecticides, biomass, biomass exploitation etc., Tremendous impact has been generated in medicine, industry and agriculture.

In India, the national biotechnology board has chosen genetic engineering, photosynthesis, tissue culture, enzyme engineering, alcohol fermentation and immunotechnology as areas of immediate interest. The scope of biotechnology in improving agricultural produtivity needs to be brought into focus and the Agricultural Universities must take a lead in increasing the quality food for the future. We have already witnessed the great success of green revolution in India during the last two decades. Effective inputs need to be introduced

into our crop production. Microorganisms play a tremendous role in biotechnology and agricultural productivity.

The Biological Nitrogen Fixation (BNF) by several soil microbes is still a major process in maintaining the soil fertility and increasing the crop production. The major microbes involved in BNF are *Rhizobium, Azotobacter, Azospirillum, cyan bacteria,* and *Azolla;* although half a dozen of others such as, *Frankia, Derxia, Klebsiella,* Pseudomonads and endosphere microbes are well documented as nitrogen fixers. BNF in grain legumes and forage legumes has been the subject of research in a number of nationally and internationally supported projects. The high cost and restricted availability of nitrogenous fertilisers pose a serious and continuing problems for crop production. These problems are likely to become more critical in future particularly in developing countries. BNF is naturally taking place, however the nature can do a better and faster job if we select a better strain, compatible host and create a better condition such as favourable amount of moisture, PH, plant nutrients etc. The improvement of 10 per cent BNF is a realistic goal with organised research. This would be roughly equivalent to an addition of about 20 kg nitrogen per hectare per year; at a basic cost of approximately Rs. 100 per ha. This would are annually at least Rs. 600 crore in India. The inoculation of many legumes with highly effective strains of *Rhizobium* increased grain yield by 25 to 30 per cent apart from saving in fertiliser cost. The BNF research, need to be intensified in the following areas :

1. Survey and ecological studies of nitrogen fixing microbes including evaluation of benefits of inoculation and interaction with host germplasm and other related microbes, and chemical, fertiliser, insecticide, fungicide etc.,

2. Genetical studies to enlarge host spectrum by mutation, conjugation, transformation, transduction and plasmid biology.

3. Somatic hybradization, tissue culture technique for fusion of protoplasm of bacteria and plants.

4. Regulation of nitrogenases and hydrogenases and Nif-gene.

5. Interaction with phosphate solubilisers, cellulose solubilisers to enrich the soil fertility, organic matter etc.

6. Associative nitrogen fixers, the study need to be intensified as they involve in cereal crop production.

7. Frankia biology should be extended to forest tree production.

8. Culture repositories must be maintained in all the agroclimatic regions.

The Organic Matter Decomposition and Recycling study (OMD) is a next important process in the biotechnological study of Agricultural Microbiology. Agricultural and urban waste has to be recycled faster and useful product must be achieved. Studies in enrichment of compost, production of alcohol from waste starch and cellulose by-products, single cell protein production from organic wastes, mushroom production on agricultural waste substrates, biogas production from organic wastes, edible oil production from microbes multiplied on sugar industry wastes, etc., have to be intensified. Hundreds of fungi and bacteria are capable of digesting lignin, cellulose, starch, such as *Trichurus spiralis, Paecilomyces, fusisporus, Aspergillus* sp., *Penicillium* sp., *Aspergillus awamori, Scoupulariopsis sc,*

etc. There are other organisms which efficiently degrade harmful pesticides, help rooting the plants (ecto mycorrhiza, endomycorrhiza, *Agrobacterium rhizogenes*). There are soil microorganisms capable of destroying harmful insects, plant pathogens and other parasites. All the useful soil microbes need to be harnessed, selectively isolated and maintained in culture banks. The soil microbes are capable of producing antibiotics, aromatic amino acids, rare biochemicals such as plant harmones, vitamins, organic acids, and other drugs. These areas need to be explored. Wide opeh area is the microbiology of sea and ocean. Wonders are awaiting at the anearobic microbial world; we need to explore! Biotechnology can regulate the natural world; without upsetting the balance of the delicate environment !.

STRATEGIES FOR THE DEVELOPMENT OF SMALL FARMERS BY TWENTYFIRST CENTURY

C. NANJA REDDY, R. RAMANNA and J. V. VENKATARAM

It is estimated that the total population of India would be around 950 million by twentyfirst century which require over 250 million tonnes of food grains. In Karnataka nearly 60 per cent of the farmers have got less than five acres each. It is estimated that the average size of holding in India is about 4 acres, indicating on an average all farmers are small farmers.

In Karnataka the number of marginal and small farmers in 1980-81 were increased by 13.3 and 15.7 per cent, respectively, from 1976-77. This trend indicates that small and marginal farmers form the bulk of the farming community by twentyfirst century. The unemployment and under employment have been continuously increasing among these farmers.

It is estimated that nearly 70 per cent of the cultivable land is under rainfed conditions. Hence, by 21st century good part of agricultural production should be produced by small farmers on large stretch of low rainfall areas. It is imperative that agricultural development by 21st century has to develop strategies to augment income and employment opportunities of these small farmers who form the bulk of the farming community.

An attempt has been made in this monograph to identify the problems of small farmers and to find out the possibilities of augmenting their income and employment based on the findings of the research studies conducted on small farms.

Definition of small farmers

Based on the S.F.D.A. criteria farmers owning land holdings between 2.50 and 5 acres of dryland or 1.00 to 2.50 acres of irrigated land or its equivalent (one acre of irrigated land was considered equivalent to two acres of dryland) were considered as small farmers.

Unirrigated and irrigated small farmers

The farmers who owned irrigated area of 27 per cent or more, of the net area sown were considered as irrigated farmers and those who owned less than 27 per cent were treated as unirrigated farmers.

Optimum plans of small farmers in channapattana block Bangalore district

The results of the optimum plans of unirrigated small farmers under improved technology with adequate capital indicated that area under rainfed ragi decreased from 76.86 per cent in existing plan to 24.16 per cent of dryland. On the other hand the area under rainfed mulberry increased from 9.72 per cent in existing plan to 56.71 per cent in optimum plan. Similarly, in case of irrigated small farms, the area under rainfed ragi was decreased from 91.16 per cent in existing plan to 56.44 per cent of dry land in optimum plan. It was interesting to observe from these results that area under rainfed mulberry on irrigated farms was also increased from 6.19 per cent in existing plan to 41.56 per cent of dryland in optimum plan. The area under irrigated mulberry on irrigated farms was also marginally increased from 25 per cent in existing plan to 30 per cent of irrigated land in optimum plan. Thus the optimum plans of both the categories of farms suggested relatively larger area under capital intensive and

more profitable enterprises as compared to those of existing plan, making provision for the production of sufficient quantity of foodgrains required for family consumption. Further findings of this study indicated that three crossbred cows could be reared on both the categories of farms by feeding the fodder, produced on their farms.

Income

Provision of adequate capital in conjunction with improved technology indicated that the income of unirrigated small farms could be increased from Rs. 1212 in existing plan to Rs. 7285 (by 501 per cent). In the optimum plan of these farms the sericulture(31 per cent) and Dairy (59 per cent) were together contributed about 90 per cent to the total income.

Similarly, the irrigated farms increased their income from Rs. 3017 in existing plan to Rs. 10,703 in optimum plans (255 per cent). The income from dairy and sericulture amounted to 84 per cent of the total in optimum plan.

The income of irrigated farms was increased by 149 per cent and 47 per cent over their unirrigated counter parts under existing and optimum plans, respectively. This was mainly due to the fact that irrigated farms had better irrigation facilities as compared to that of unirrigated farms.

Employment

Under improved technology in connection with adequate capital, employment increased from 365 mandays in existing plan to 1058 mandays per annum recording an increase of (693 mandays) 190 per cent. The employment

potential generated by sericlture and dairy in optimum plan of these farms amounted to nearly 95 per cent of total employment. The optimum plan of irrigated farms provided total employment to the extent of 1075 mandays per annum which amounted to 101 per cent higher than that (536 mandays) of existing plan. Sericulture and dairy together provided employment opportunities for 503 mandays and 372 mandays, respectively, which together amounted to about 90 per cent of the total employment.

Thus the findings of the study indicated that introduction of sericulture and dairy with improved technology with adequate capital not only augmented the income but also provided gainful employment on small farms in general and unirrigated farms in particular.

Based on the findings of this study (Nanja Reddy, C. 1980) the following strategies are suggested for the agricultural development in 21st century.

(i) The crossbred cows not only provide gainful employment to the members of the family throughout the year but also augment the income on small farms. Hence top priority should be given to populanise crossbred cows among small farmers in general and unirrigated small farmers in particular by providing capital and marketing facilities. Similarly poultry and piggery must be popularised among small farmers wherever possible.

(ii) The contribution of sericulture to the total income and employment opportunities on small farms was commandable. Hence, the high yielding varieties of mulberry as well as improved breeds of silkworms should be further popularised among these farmers by providing adequate capital and infrastructural facilities like marketing etc.

(iii) The introduction of improved technology under optimum plans has resulted in the reduction of area required to produce food grains sufficient for family consumption. As a result additional area was allocated among more profitable crops like mulberry. Hence it is imperative that high yielding varieties of crops and scientific dry farming practices must be popularised among small farmers.

(iv) The increase in income on irrigated small farms over the unirrigated counter parts was mainly due to the availability of better irrigation facilities on irrigated farms. Hence, it is imperative that adequate steps should be taken to provide irrigation facilities by sinking community bore wells as in the case of Harijans and other weaker sections. The amount spent towards sinking of bore wells and installation of irrigation pumpsets may be recovered in instalments as in the case of soil conservation programme.

(v) Above all it is imperative that the managerial ability of these small farmers, which is an important intangible factor in farming must be improved. This might be done by encouraging "whole farm demonstrations" on small farms which deals with economic content (economic viability) in agricultural development.

These measures, besides accelarating the agricultural development in twentyfirst century, would help in reducing the disparity in income among the farming community in rural milieu.

REFERENCES

(Nanja Reddy C. 1980.) "Income and employment potential of Small Farmers in Channapatna Block, Bangalore district" Ph. D. thesis submitted to the University of Agricultural Sciences, Bangalore.

A HYPOTHESIS ON AGRARIAN CRISIS

H. SOMASHEKAR

We can classify agrarian crisis in two phases, after independence, first phase starting from 1947 and ends up in 1980. Second phase has begun in 1980 and still it is continuing. I shall like to elaborate above mentioned thinkings with the tools of sound ideology, which may maker a way to start useful journey into contemporary India.

The first phase of agrarian crisis had links with industrial capitalism. The second phase is attempting to break this linkage, these are the contradiction or paradox of Indian agrarian development that we can see.

The basic change that occurred in terms of land tenure system, credit structure and all these things were compliments to the industrial capitalism that was in incipient stage during 1950. Without these basic changes in agrarian structure it was a hard to dream development of industrial capitalism, in the words of a noted economist Gilbert T. Brown substantiates my argument; he says that the ruling class have prejudised assumption about development of the industrial sector at the cost of the agricultural sector; therefore they deliberately keep farm commodity prices at a lower rate and simultaneously they wish to increase production by pursuing biased policies thereby a large transfer of income and foreign exchange from agriculture to industrial sector takes place, this clearly discloses the vested interest of Indian ruling classes therefore we can sum up the essence of the institutional change that had occurred during the sixties and seventies were in unison to the industrial capitalism.

Resource transfer from agriculture to non-agriculture during 1965-66 at current prices was Rs. 1015 crores. This may be an example to analyse how the agriculture sector has been exploited to satisfy the thirst of the industrial capitalism which is essentially needed for its survival.

To some extent these crisis fulfilled the egalitarian urge of the tenant classes. While glorifying social justice which had been accomplished at this juncture, we should not forget the forces which played behind this crisis, without dislodging the feudal set up, which was the legacy of the British. They (capitalist) could not see the growth of industrial capitalism therefore they helped the tenant class to get released from the shackles of slavery. The main consequences of the new agricultural technology is the creation of regional imbalance, accentuation of class differentiation, growth of five star culture, all these are once again a part and parcel of industrial capitalism. The first phase of agrarian crisis lies in the growth of industrial capitalism in India. However, the Indian ruling classes helped to accomplish this from institutional change and modernisation of agriculture sector.

The second phase began during the later part of the seventies and continues even today. This phase has total dialectical relationship with the industrialist capitalism. Whereas the previous phase had a complimentary or harmonious relationship with industrial capitalism. In this phase we can see the emergence of a new agrarian structure or mode of production. Because of this phenomenon we can foresee a crisis which will eventually wreck industrial capitalism. This would lead to the emergence of the peasentry and intensification of the problem around the price question. Farmers will mere vehemently demand remuneration prices.

Therefore, I like to give some emphasis on the importance of farm prices and their impact on the peasentry. Some may say that today most of the farmers have shifted over to commercial crops but the underlined reason for shifting from food grains to commercial crops is, these crops do not fetch reasonable prices based on the scientific approach of computing cost. While fixing the prices the government uses an arbitrary approach for agricultural commodities compared to industrial products. Suppose the farmer shifts from food grains crops to commercial crops that is only because of the attractive apparent prices. Even so called attractive prices are much more lower than prices in the world market. Why do we find this type of price disparity? Theodure W. Schultz has coined the phrase " Political market " which means intervention by the government to satisfy its political goals. Generally, in under-developed countries specifically in India this political market favours the urban population at the direct expense of rural people. For example in Pakistan during 1966, 348 million rupees and in 1976, 1540 million rupees of income was transfered from wheat farmers to urban consumers, due to biased policies. Therefore urban consumers and industry, demands cheap food and raw materials. Here we can see the under-value of agriculture sector by Government.

Some may putforth the argument, how could the farmers who are taking ventures in commercial crops manage to get profit and remains in production? The answer is simple because these farmers who grow cash crops are not farmers of the peasent economy, rather they mostly have come from either ex-zamindharis, business sector or contractors and semi industrialists. These types of spurious farmers accumulate the capital by extracting cheap labour which is available

in our country side and they divert their capital investment in non-agriculture sector for its regeneration. In post independence India, we can see such spurious golden collar farmers amidst of impoverished farming community. These spurious farmers can afford the new agricultural technology which is necessarily a capital intensive and also import intensive. Therefore an ordinary farmer cannot and will not wish to shift from foodgrains to cash crop because the technology necessarily is capital intensive and import intensive. Finally, I can say that farming community cannot elevate their standard of living only by cultivation because we have seen that Indian agriculture has been under–valued to establish industrial capitalism. Today the farming community is getting more political consciousness and they are aware of their plight in terms of poor prices, this is really a big crisis in rural India.

Now we can see how the Agriculture sector has been under-valued, if we take harvest price index of agriculture commodities like Ragi (200), Paddy (200) and price index of agriculture inputs like pesticides, (436.2)/ electricity,(411.2)/ Iron and Steel (467.2) we observe that price index of agriculture inputs raising substantially and simultaneously harvest price index of agricultural commodities have remained relatively stagnant. This shows that the farmers have been denied their decent standard of living by our ruling classes.

Another phenomenon of industrial capitalism is where industrialists fix prices for their commodities based on their cost of living index. However they may not compute cost of living index but they fix prices at least their industry should support their luxury life style. Where the farmers do not have such opportunity therefore at least Government should fix prices for Agricultural commodities based on cost of production and cost

of living index because farmers not only produce but also consume. The prices of the industrial and other non-agricultural commodities like leather products (409.9), canned and preserved fish and sea food (436.6) cosmetics, soap and detergents (327.1) and Fuel, power and light (516.5) petroleim crude (1939.5) have been rising it we compare to Argicultural commodities, like paddy (200), ragi (200), sugarcane (202) and cotton (201).

We can pin point the problems of the agriculture as the cost index (input price index) of agricultural commodities and the price index of industrial commodities are rising while the price index of agricultural commodities is relatively stagnant. These components are the characteristics of domineant industrial capitalism. These are the root causes of the second phase of the agrarian crisis.

Already we have observed the politicization of farmers in favour of scientific prices for their commodities. Therefore the second phase decides which sector should be dominant, either industrial or agriculture. This crisis makes a dent into the hard core industrial capitalism. Hence the second phase of the crisis is dialectical nature.

Suppose we overcome this second phase of the crisis, we may see the third phase of the agrarian crisis. During this phase agriculture labour problem will be the main issue, but today the peasantry plight under the shadow of industrial capitalism over lapse the agriculture labour problem. Without solving the present agrarian crisis we cannot accomplish what we have conceived in our constitution for rural development - building a viable and prosperous agrarian economy.

A NOTE ON THE POTENTIAL AND PROSPECT OF MUSHROOMS IN INDIA

T. N. PRAKASH, TEJASWINI, and R. RAMANNA

The Government of India has persistently emphasised the importance of exports of the agro-based sector due to certain advantages it offers by way of employment generation and gainful utilization of natural as well as farm resources. The Botany section of the Indian Science Congress has emphasised that steps should be taken to make Mushroom farming a profitable cottage industry in rural areas. The commercial cultivation of mushrooms is gaining momentum during the recent years as one of the significant export oriented agro-industrial enterprise. This article tries to explore the prospect for mushroom cultivation in the country.

Global output and Indian situation

While precise data on world production is not available, the annual global output estimate of fresh mushrooms is around 9 lakh tonnes, half of which is reported to be sold in the frozen form mainly for internal consumption in the producing countries. Leading suppliers to the world market are Taiwan, China, France and Netherlands with a combined share of about 30 per cent of the world trade in the year 1981. Global imports of the items mainly in the canned form, increased from 1.72 lakh tonnes to about 3 lakh tonnes from 1976 to 1981.

The commercial production of mushrooms in India is of a very recent origion. In fact, for the first time during 1964-65 the Department of Agriculture, Jammu and Kashmir cultivated mushroom successfully on commercial scale. Among many edible types of muchrooms only a few could be grown successfully on large scale under artificial condition. In India commercial

cultivation is restricted to only three types of mushrooms namely Button mushrooms (*Agaricus bisporus*), Paddy straw mushrooms (*Volvariella sp.*) and Oyster mushrooms (*Pleurotus sp.*). The later two can be cultivated extensively in tropical climate. Bulk of India's production of mushrooms (80 per cent) comes from Himachala Pradesh and Jammu & Kashmir. In recent years it is becoming popular in the hilly tracts of Nainital, Almora, Mussorie in U.P., the Nilgiris in Tamilnadu and Bangalore in Karnataka. The estimate of annual production of mushroom made on the basis of spawn (seed) supplied to the growers by the major spawn production centres of the country indicate an output of 1,500 to 2,000 tonnes.

Nutrition and utilization : A relative analysis

Mushroom is popular for its delicacy and flavour, with an excellent source of protein, vitamins and minerals. It is a balanced food for diabetic patients and for those who wish to reduce obesity as it has low content of fats and carbohydrates. For instance 100 g of Oyster mushroom contains 47.93 per cent of protein, 2.26 per cent of fat, 0.285 per cent sugar, 0.121 per cent starch, 11.46 per cent minerals and 17.47 per cent vitamins on dry weight basis. Though meat is a rich source of protein, its prohibitive price is a major limitation for consumption. Being a plant (fungal) origin, mushrooms could be a cheap and available alternative in the menu of both vegetarians and non-vegetarians. In the context of inelastic supply of land, the impetus for mushroom cultivation assumes importance as it is a non-land based activity, generating relatively more protein (46 per cent) than even the protein rich (land based) soyabean (40 per cent).

Due to high price and lack of publicity, the consumption of muchroom is confined mainly to the Foriegn tourists and local affluent classes concentrated in the metropolitan cities. In the early seventies, the internal production was not sufficient to cope with the rising demand and the country had to

import (11,007 kgs valuing Rs. 1,57,794 in 1974) in order to meet its internal demand. Henceforth, the country was able to increase its production to the level to meet its domestic requirements. But, this does not give room for complacency since, mushroom is a commodity which is income elastic, where, with the rising per capita income there would be enormous demand in the future which serves as a prospect for increasing its production.

Economics of mushroom cultivation :

The mushroom could be cultivated on various scales ranging from a farm with 600 trays taking 4 to 5 crops per year to a small household of 30 beds with only one crop per year using one tonne of paddy straw. They could also be taken up in small, rural and urban households. By using one tonne of paddy straw, 100 kg of mushroom could be cultivated at a cost of around Rs. 700. The cost of paddy straw forms around 35 per cent of the expenditure followed by wages (21 per cent) and the seed material (17 per cent). At an average price of Rs. 15 per kg a net income of around Rs. 800 could be realised with an approximate benefit cost ratio of 1.90. In the cultivation of mushroom it is an eye catching observation that diseconomics of scale operate when cultivated on large scale countering the economic normalities. In fact the benefit cost ratio decline from Rs. 1.90 to around 1.60 when the production unit increase from 100 kg mushroom to around 2.000 kg mushrooms, perhaps because of high and sophisticated investments. However this is an important and useful exercise for the economists to venture upon.

The labour intensiveness of the enterprise is another attractive feature as it could employ annually around 1000 mandays of labour to raise around 3000 kg of mushrooms.

Export and potential

India's export has been confined mainly to the dry Guchi

variety, which originates from the upper reaches of Himachal Pradesh and Jammu & Kashmir. India's export earning was Rs. 21.1 million in 1982-83 by exporting 46.5 tonnes of mushroom. The major destinations for India's export are the developed countries which include France, Switzerland, U.S.A., U.K. and the Federal Republic of Germany. The country could emulate the methods followed by Taiwan to increase the production of mushroom. Taiwan had the lowest rank among mushroom producing countries in the year 1960, but in a brie- period of 6 years its production went very high, that it achif eved the III rank and has also maintained it since then. This was possible by encouraging pioduction of mushrooms on small units in the rural sector, by offering export - incentive to tap the global export potential and by the programme of the Government in providing technical knowhow and in marketing. India has the requisite resource endowment to exploit the growing world trade in mushroom since the international trade in mushrooms is expanding at a very fast pace. Varied agro-climatic conditions, vast resources of agricultural waste like wheat and paddy straw and cheap labour supply in India should be exploited to produce more mushrooms and enter the export market.

Certain suggestions for consideration :

1) Adoption of the modern technology in mushroom cultivation.

2) As mushroom industry in India is yet in its infancy, the institutional finance to the mushroom entrepreneurs with a nominal interest rate could be thought of.

3) Extension of the support to the mushroom researcl and extension education programme.

4) Provision of good quality disease-free spawn at chea per rate.

5) Special subsidy programme on export of mushroom till the industry gets established.

6) Development of canning industry is a must for developing mushroom cultivation in a big way. It will be necessary for agro-industries development corporation to go in a big way for mushroom canning.

7) An integrated marketing system is useful in safeguarding the interest of both producers and consumers.

8) Vigorous promotional activities are needed to popularise mushroom and increase domestic consumption.

AN APPROACH FOR VERTICAL PRODUCTION AND SELF EMPLOYMENT TO IMPROVE AGRARIAN STRUCTURE AT VILLAGE LEVEL IN 21 st CENTURY

B. S. NAIDU

In 15 years by now the 21st century will be born with an expected monstrous population growth of nearly 900 million people to be fed in India.

India should develop skills and strategies to produce 250 million tons of food grains to feed its population at the rate of 750 grams of food per day per individual.

The net area sown in the country is around 145 million hactares. There is no scope for any further horizantal - expansion of production in view of the fact that most of the aerable land has already been brought under cultivation. Therefore, any increase in food production should only be planned in respect of vertical increase. This calls for high intensity of crop production per unit area and strategies to develop suitable cropping systems at the village leval.

There may be quite a few ways of achieving this goal but in this paper some line of thinking with respect to irrigated cropping system approach that could be adopted for the red sandy loam soils of Mandya and Mysore districts irrigated by the Cauvery Canal systems [KRS] is indieased as a case study.

The existing cropping intensity in the area is largely mono cropping or at the most two crops are taken in a year. There is significant scope to introduce triple cropping system aimed at the following :-

a] Increasing total returns per hactares.

b] Self Employment

c] Byproduct utilization.

d] High cost benefit ratio.

e] Soil health.

f] Agro-Forestry.

g] Farm energy.

a) Increasing total returns per hactares

The existing practice in the area is largely one crop per year or at the most two crops, one in main season [Kharif] and other during Summer. The common cropping sequence is rice-rice or rice-ragi/groundnut. The introduction of triple cropping would result in vertical production with total returns estimated at 0.5-11.0 tons/ha.

Tripple Cropping Model

Season :

June, 15 October	November February	March June, 15	Total returns year
Crops			
Rice-135	Cowpea, Soybean, Sunflower, Niger,	Ragi. Groundnut Maize, Sunflower	
Returns/hactares			
5.5 - 6.0 tons	1.0 - 1.5 tons	3.0 - 3.5 tons	9.5 - 11.0 tons

b) Self Employment

The cropping system approach for an area should be designed in such a way that it would provide employment throughout the year for farm family. Since the system envisages high intensity cropping the farmer is engaged throughout the year on the field. The self employment could also be generated through agro-based by-product industries.

c) By Product Utilization

Rice is the principal crop grown over an area of 1.18 lakh hactares in the area. Cottage industries to make use of its by products such as straw, rice bran, husk, etc., could be developed. There is scope to set up rice based agro-industries to extract oil from bran, produce low quality paper from husk and utilising the straw for mushroom cultivation, mattress, bins, rope marking, etc.

d) High cost benefit ratio

There is need for reducing the cost of cultivation for high cost benefit returns. This calls for substitution or supplementing of purchased inputs [like fertilizer, plant protection chemical etc] through naturally produced resources.

The line of thinking in this direction as suggested by Dr. M.S. Swaminathan, Director General, IRRI are as follows :

i) Genetic methods of costs reduction.
ii) Substitution of market purchased inputs with farm grown inputs.
iii) Improved management of purchased inputs.

i) Gentic methods of costs reduction

In summary, this calls for developing of stress tolerant (disease, pest, adverse soils, drought, claimatic hazards) crop varieties for stabilized production.

The stress tolerant varieties such as Rasi, Mandya vani, Karna, Mahaveer etc. released by the UAS, and IR-30864 in offing for salt tolerance could be cited as examples of genetic cost reduction.

ii) Substitution of market purchased inputs with farm grown inputs

There are several ways of substituting/supplementing the market purchased inputs especially nitrogenoues fertilizers.

The 'N' fertilizers for paddy could be supplemented through use of azolla, blue green algae (BGA) and through incitu incorporation of N-fixing fast growing leguminous crops etc. Recent studies at IRRI have shown the stem and root nodulated leguminous species namely *Sesbania rostrata* can fix up considerable amounts of nitrogen in a short growing period of less than two months in flodded soils.

iii) Improved management of purchased inputs

This calls for efficient use of purchased inputs through refinement of fertilizer use technology.

In rice Nitrogen (N) losses in flodded soils occur due to a variety of reasons such as volatalization of amonia, nitrification, fixation' leaching, runoff, seepage etc. Several techniques for minimising 'N' losses are available and the following could be cited as an example.

In experiments at Mandya, USG applied at 60 kg/ha has given the same yield as 100 kg N/ha in the form of prilled urea. This accounts for a saving of 40 kg N/ha with cost reduction by around Rs. 200/ha.

e) Soil Health

Soil is the media for crop production. Unless the soil health is guarded there shall not be any long term production planning. The cropping systems approach which will facilitate rotation of crops such as cereals, pulses, oil seeds etc., should be designed in such a manner so as to avoid continuous flooding. Incorporation of seasonal crop residues incit will improve the soil microbial activity and also the texture of the soil. The crop sequence should enable cutting down the life cycle of specific pests and diseases.

f) Agro Forestry

The Agrarin community in the rural areas should be activated to adopt agro-forestry. The un-utilised land space

such as farm boundaries, hillocks etc., could be very well made use of for planting of fast growing dual purchase forest species for fuel and feed for live stock.

g) Energy on the farm

The minimum live stock maintenance and uilisation of animal wastes for producing energy through establishment of low cost energy plants such as Bio-gas/Bhagyalaksmi are to be encouraged on extensive scale.

Conclusions

In summary, it could be stated that the overall improvement of agrarian structure at the village level calls for suitable legislation to be framed on cropping systems to increase the yield per hactare and development of agro-based industries to generate self employment.

The current level of productivity of food grains in the country is around 1.0 tons/ha. If this could be raised to 1.75 tons/ha. through intensive cropping then it should be possible to produce a total production of 250 million tons of food grains by around 21 st Century, which should not be difficult.

STRATEGIES FOR LIVESTOCK HEALTH COVERAGE

S. J. SESHADRI, R. N. SREENIVAS GOWDA and S. K. VIJAYASARATHI

Introduction

Health is the basic essential for ensuring profitable production and optimal reproduction in livestock. Maintenance of health by disease control and prevention therefore requires to be viewed with top priority. Lack of appropriate or organised efforts could affect adversely the very purpose and economy of livestock production programme.

Programmes for livestock development need to be viewed in terms of the fact that 75% of the population live in villages, averge farm size is 2 hectares, major part of the draft power (more than 64 per cent) for farm operation and rural transports comes from bullocks/other animals and 30 per cent of the rural families are landless.

Livestock develoment programmes thus have a significant role to play in meeting the food requirements of millions and also in determining vitally the economy of the agricultural sector and rural population.

Status of livestock production

The livestock population in the country have become progressively and systematically increased through intensive development projects, crossbreeding programmes and artificial inseminations and based on a review of the three livestock census, it has been seen that individual livestock species recorded approximately 10 million increase every five years and it could be reasonably expected that the size of the population to be handled by the turn of the present century

could be 2 to 3 times more than what we are handling at present.

Disease problems, their nature, work done and achievements

Disease problems of livestock have been of varied nature ranging from devastating epidemics accounting for mortality losses to those that are frustratingly crippling the economy of production. Disease picture in the developing countries including that of ours have become more and more complex due to a mosaic interaction of factors concerning breeding programmes with exotic germplasm, modern husbandry practices in feeding and management of productive economy.

While reviewing the essentials of disease control in tropics, it has been rightly pointed out by eminent workers that " much has been done ; much is being done and more is required to be done ".

Research on diognostic and prophylactic measures against important diseases of livestock has been in progress in this country for almost a century at the Indian Veterinary Research Institute and other institutes and many important contributions have been made such as in developing potent diagnostic reagents against diseases and vaccines against most of them. It is because of these efforts in efficiently providing control measures for some of the most devastating diseases, that livestock production programmes had achieved tangible results and given courage and confidence to farmers to take advantage of these programmes.

Veterinary care facilities current status

There has been a phenomenal build up of veterinary health care facilities in the past two decades. The research output from the I.V.R.I., Agricultural Universities, dairy development projects and the biological products institutes have brought to

light the emerging disease problems either as introduction of exotic diseases alongwith imported superior germplasm, manifestation of known existing diseases in altered or virulent form in imported and crossbred valuable and highly susceptible livestock or failures to vaccinations due to immunosuppressive diseases.

In as much as profile and trends of disease problems have become transformed compared to earlier decades and in view of the anticipated build up of the existing population to 2 to 3 times more, efforts are to be put forward in strengthening the research and teaching institutions as well as the state departments of animal husbandry and veterinary services.

Requirement of health coverage and strategies to be adopted

Disease control or its eradication through routine prophylaxis in such a large livestock population as that of ours is not possible. It is necessary therefore that systems of surveillance, monitoring and forecasting are developed. By this arrangement or organised efforts, it will be possible to forecast disease outbreaks and undertake suitable prophylactic measures.

In this direction, diagnostic laboratories equipped to handle techniques of timely recognition of infectious diseases both existing and emerging types, need to be established at strategic locations in the various states. These locations should be such that time consumption through travels to trouble spots is kept at minimum and transport facilities in the form of suitably equipped mobile units provided.

Agricultural Universities and institutions handling disease investigations could collaborate with state departments of Animal Husbandry and Veterinary Services in establishing these research cum-service field diagnostic laboratories. Such laboratories, as per an earlier recommendation of Government

of India to a dairy project in the State could be even one each at District levels for better efficiency. This facility in addition to developing systems of disease monitoring, disease diagnosis and control will also enable parasitological surveys and help corrections and prevention. It may be mentioned that nearly 50 to 60 per cent of the valuable livestock population harbour gastrointestinal parasites which could seriously deplete the nutritional status and hamper productive economy.

This facility will also effectively serve as perepheral research units to main research laboratories at states, regional and national levels thus enabling well planned and organised efforts at developing disease control systems.

Strengthening of existing Institutes of Veterinary biologicals and establishment of newer once in areas/states where they are not in existence is yet another programme for consideration in the interest of meeting the requirements of livestock health coverage of 2000 A.D.

STRATEGY OF MILK RECORDING FOR INCREASING MILK PRODUCTION

A. V. RAI and B. P. HEGDE

Status

India has launched massive cross breeding programme for the production of crossbred cows. Cross breeding of cattle is practically a national policy as it is the quickest and surest way of boosting national milk production initially. Crossbred cows are a hopeful source of milk for billion people of 21 st century, additional source of income to rural small farmers and a tool to reduce the socio-economic imbalance.

Due to want of standardised offical milk recording, the benefits of developmental programmes are not recognised. Due to want of facts which can be got from milk recording, experts are not able to plan appropriately. All exotic breeds available are used for cross breeding. Some are given up later which means wastage of resources and delay in progress.

Recent studies have concluded that the exotic blood in crossbreds must be restricted to 50 per cent. It is quite easy to produce crossbreds of 50 per cent exotic blood and to maintain that blood level in the population. Jersey is accepted as the breed of choice for cross breeding cattle in India. Fresians and Brown Swiss are accepted here and there.

By cross breeding cattle, the milk production of the nation can be hiked high within a short period. Further improvement will be small and it depends upon scientific skilful selection, particularly of breeding bulls. Continuous increase in milk production is essential even if population remains static since people will consume more milk as illiteracy disappears and economic condition improves. Currently, bulls

are selected from cow herds of few institutions. These herds do not form even a drop in ocean of cattle population. Occasional milk yield competitions do indicate that there can be many better cows with private farmers. They are not identified effectively and selectively mated to produce better bulls to improve the cattle population. The available genetic resources are not utilised. Standardised official milk recording will identify such cows. Owners can be encouraged to produce best bulls by offering attractive prices for such bulls. With A.I. practice, best bull can be offered any price because it can sire thousands of better cows. It will be a worthy national investment.

To meet the demand of milk of early 21st Century, about 60-70 million crossbred cows of good production potential is said to be necessary. Cow strength cannot grow with human population to produce milk requirement. Hence the quality of cows should be improved in each generation. If 10 per cent of 60 million cows are brought under official milk recording (some countries have more than 50 per cent on milk recording) and if one per cent of them (0.1 per cent of 60×10^6) are identified as bull mothers, annually 30,000 bulls with high pedigree will be available for progeny testing. If only 20 per cent of them are to be retained after progeny testing, there will be 6000 bulls promising to improve cattle population.

Employment

Milk recording will be the best suited part time employment for the rural underemployed and unemployed population. Animals are scattered in rural parts. If one is to record five animals per day (150 animals per month), recording 10 per cent of 60 million cows will provide part time employment for 40,000 people. If they are trained on elements of dairy cattle husbandry, they can change the rural scene very much. If higher percentage is brought under milk recording more of employment is generated and better will be the effect. The

remuneration may be based on the number of records an individual makes.

Suggestion

The Dairy Herd Improvement Association of America (DHIA) is concerned with milk recording in U.S.A. Daily milk recording is impracticable. Interval recording which will give adequately accurate estimates without any bias is needed. The milk recording was started on weekly basis in America. Interval is elongated without losing much accuracy and creating bias. Currently, monthly interval is mostly practiced. Research on the methodology is continued to reduce the labour and cost without losing efficacy.

The research work done at UAS on milk recording on field data had proved that varied interval of 21 to 35 (28 ± 7) days was highly efficient and quite practical.

Milk Federations with their subsidiaries, semen banks and Agricultural Universities must lead and get involved in this programme for (1) their own benefit, (2) farmers' benefit and (3) national benefit.

The basic work (recording animal-wise) can be got done through the field milk recorders of the primary societies of milk producers. Systems and supervisions should be built into the mechanics to avoid the manipulation. The basic data collected need be sent from the societies as and when done every day. They can be pooled and processed at Union/ Federation level for establishing facts on individual animals, identifying best animals, establishing regional / national, seasonal/periodical averages. From such facts, farmer can study his animals and plan for their own management, feeding and breeding.

With the data generated, better animals can be identified, females can be nominated to be bull mothers and bulls will

be proved. Bulls with better proofs will replace those with poorer proofs and it will provide, generation after generation, animals of higher production potential.

Finance required will be really substantial. An Institution or Government cannot afford the expanding milk recording programme. In the democratic countries, it is a farmers' programme. Half or a paisa from the litre of milk handled at the Union or Federation level can provide the finance for this programme to improve the cows and buffaloes, generation by generation, to provide milk for growing population without increasing cattle population.

The attempt is to convince on the system and finer details of plans and budgets can be worked later.

AGROFORESTRY : A SELF-SUSTAINED RURAL DEVELOPMENT PROGRAMME

M. R. ADAVANI, H. CHANDRASHEKAR and P. K. MANDANNA

Introduction

Intimate relation between man, nature and animal needs restraint on the growth of population and destruction of forest. Vast reserve of forest wealth as well as forest area got reduced as a result of grazing by animals in forest area and conversion of virgin forest land into agricultural land for food crops. The concept of economic well-being led to shift in emphasis from food crops to cash crops. Ruthless destruction of forest and rapid exploitation of agriculture, for meeting the requirements of fast growing population and also the needs of growing industries in the form of raw material, has caused not only ecological imbalance but also economic disparity between urban and rural people, especially in developing countries. This has made the scientists and planners to visualise the catastrophe of world becoming unfit for human habitation if the destruction of forest as well as the widening of gap between rich and poor is not checked immediately. Plans are being formulated all over the world to control growth of population and conserve forest and at the same time efforts are also being made for the economic upliftment of the poor through formulation of development programmes. As a result, the concept of agroforestry was formulated in 1977 at world level.

Development of agroforestry concept

The practice of planting woody trees on agricultural land to meet basic needs of farmers such as food, fodder

for animals, clothing, fuel and shelter can be viewed as a prototype of agroforestry concept. Agroforestry was initially viewed as a *local ecosystem* consisting of one plant of agricultural system and another of woody tree system combined for mutual benefit of the both. This concept was further widened by bringing into its ambit other systems such as horticulture, silviculture, pasture, animal husbandry, fisheries, poultry with at least one of the components of the agroforestry system being woody tree species. The modern concept is to visualise *agroforestry* as a *self-sustained rural development programme* with twin objects of evolving micro-ecology and creation of micro-economy suited to different agro-climatic regions in the rural sector through personal involvement of farmers and absorption of locally available labour force by creating conditions favourable for rural industrialisation. Thus agroforestry programme aims at reduction in dependance of rural economy on urban sector through diversification of economic activities in rural area by evolving agroforestry systems that lead to self-sustained development of rural area in terms of optimum use of locally available institutional as well as infrastructure facilities. Hence, with its inherent quality of creating conditions favourable for evolving micro-ecology and generating micro-economy in rural areas, the agroforestry programme is capable of reversing the present trend of exploitation of forest wealth as well as rural sector for the benefit of the urban elite. It is needless to emphasise that with its potentiality to maintain ecological balance and eradicate poverty in rural areas, the agroforestry programme scores over the Integrated Rural Development Programme which has failed to identify and incorporate the importance of creation of micro-ecology in rural development.

Diagnostic surveys and experiments

Agroforestry is being practiced since long time in various parts of India. It is carried out in the form of combining coconut plantation with food crops, spices, etc., in the South West Coastal region. Cultivation of grain crops in the interspaces of multipurpose tree called Khejri, is very common in many parts of Rajasthan and adjoining areas. Need to develop agroforestry on scientific lines to improve productivity of land and also economic condition of rural people, is being felt recently. Hence efforts are being made to identify agroforestry systems suited to different agro-climatic regions of India by carrying out not only diagnostic surveys but also through experiments at Agricultural Universities and especially Agricultural Research Stations spread over length and breadth of the country. The Indian Council of Agricultural Research, New Delhi, has brought out a booklet indicating the efforts made in this direction.

Task ahead

Agroforestry being in its infancy needs time for identification of appropriate systems suited to different agro-climatic regions, taking into consideration the local availability of institutional and infrastructure facilities. The following points need careful consideration in the planning and implementation of the agroforestry programme.

(1) Agroforestry breeding programme is to be formulated for evolving varieties of plants or breeds of animals and also species of trees that form agroforestry system for different agro-climatic zones of India.

(2) Package of practices are to be evolved in a co-ordinated fashion to meet the simultaneous requirements of all the components that form systems in different agro-climatic regions.

(3) Restructuring of existing institutions and infrastructure is to be carried out with special emphasis on inter-disciplinary activities.

(4) New extension personnel are to be trained and farmers are to be educated to take up agroforestry as a profitable proposition.

(5) Involvement of Voluntary Organisations in rural areas is a must for disseminating the idea of agroforestry as a self-sustained rural development programme.

(6) Agroforestry programme is to be spread over several plan periods in a phased manner.

(7) Separate Budget allotment for agroforestry is needed due to the gigantic nature of the task involved in implementation of the programme.

Consideration of the above points in their proper perspective, emphasises the need for long range research and planning as well as training of farmers for proper implementation of the programme. Hence agroforestry programme forms hope of 21st Century in providing solution to the twin problems of maintenance of ecological balance as well as eradication of poverty through diversification of economic activities.

PROSPECTS OF INDIAN AGRICULTURE—2000 A. D.

H. S. VIJAYA KUMAR, RAMACHANDRA BHAT and S. C. HIREMATH

The contribution of agricultural sector to the national income has steadily declined from about 57 per cent in 1950-51 to about 37 per cent in 1984-85 and this is expected to fall further to about 25 per cent by the end of the century. However, it should be borne in mind that if the industrial sector has to contribute 35 per cent of national income by 2000 A.D. (as expected) the growth in the agricultural sector must never slacken from its present rate.

Conclusions

The input in Indian agriculture has shown a steady increase over the last two decades. Because of a limitation in extending the area under cultivation, intensification is called for to achieve increased supply of outputs. Because of limited capacity to produce inorganic fertilizers, emphasis should be laid on use of organic sources which are abundantly available. Future research must concentrate on dry land farming techniques so as to release the irrigated area for cultivating other important crops like sugarcane, cotton and groundnut.

It is feasible to plan in terms of agricultural growth rate of about 4 per cent per annum provided agricultural programmes are funded adequately. There being no alternative to the effective use of fertilizer and irrigation, substantial resource will have to be devoted to

agricultural infrastructure in the years to come. Expansion of production, expansion of facilities for research and farm credit system require an expanded coverage. All this means agricultural growth cannot be brought about cheaply. Considering the acute scarcity of resources and a sharp decline in the external assistance difficult questions will arise in determining the priorities in resource use.

RESEARCH AND DEVELOPMENT PLANNING FOR HARVEST AND POST-HARVEST TECHNOLOGY IN PLANT DISEASE CONTROL

K. G. H. SETTY, T. B. ANILKUMAR, A. N. SUDARSAN RAO and K. KRISHNAPPA

International awareness has been created by the reports of FAO/UN on the impending need for protection of agricultural commodities from losses due to diseases affecting crops and the commodities during harvest, transit and storage. The total world loss due to pests and diseases is estimated to be around 20 million US dollars and in India it is about Rs. 5000 crores a year of which 25 per cent is due to diseases alone. The figures at FAO/UN indicate that 5 per cent of food grains harvested is lost before it reaches the consumer and in some of the south American countries, certain parts of Africa and India nearly 30 per cent of the annual yields are lost. The national committee appointed by the Government of India have estimated food grain losses in the country during post harvest period at 9.3 per cent.

Post harvest losses are much higher for perishable fresh fruits and vegetables than for cereals and other field crops. A casual walk through any urban wholesale fruit and vegetable market, one can get a fair approximation of available post harvest losses. In USA, the overall losses in fresh fruits and vegetables between the farm and the consumer are about 12 per cent. These are much higher in the developing countries. A study in Nigeria showed that up to 21 per cent of the potential harvest was lost to rats in the field and an additional

5 to 20 per cent during marketing. A 30 per cent post harvest loss of fresh fruits and vegetables was reported in India.

The inadequate surveys and lack of uniformity in estimation of loss are the reasons for the non-availability of precise accounts of losses for various commodities. A determination of loss in the quantity (weight) of edible material is more meaningful than monetary value, which may vary with supply and demand and makes worldwide comparisons difficult, due to fluctuating monetary exchange ratio.

Many microorganisms like fungi, bacteria and actinomycetes are known to be responsible for the spoilage. Besides, the problem of mycotoxins causing disease and death in human and animal beings results from food grains spoilage.

The grain molds are those fungi which grow on or in seeds and consists of field and storage fungi. Field fungi invade grains before or during harvest under favourable moist conditions and storage fungi invade grains primarily during storage. Together they cause grain deterioration. Besides, other factors like prolonged rainfall during grain development and maturity, alternate wetting and drying, birds and insects also brings about grain deterioration. The six major types of losses in storage are :

i. decrease in germinability
ii. discolouration of part or all of the seed or kernel
iii. heating and mustiness
iv. various biochemical changes
v. production of toxins
vi. loss in weight.

Fungi are known to play a vital role in influencing the keeping quality of seeds and grain and nearly 150 species of fungi are found to be associated with cereal seeds of various kinds. The more common field fungi associated with field crops are species of *Alternaria, Cladosporium, Helminthosporium, Pyricularia, Fusarium, Ustilago, Colletotrichum, Nigrosporium* etc., and the more common storage fungi are species of *Aspergillus, Penicillium, Cladosporium, Alternaria, Rhizopus, Mucor, Curvularia* etc:

Impact of post harvest spoilage on health

The three main ways by which microorganisms being responsible for spoilage and affecting adversely the human and animal health are.

1) Allergic disorders
2) Mycotoxicoses and
3) Mycoses

Various toxins associated with post harvest spoilage are aflatoxin, zeralenone, ochratoxin, tremogenic toxin, penicillic acid, patulin and yellow rice toxins.

Factors affecting post harvest spoilage

Various factors govern post harvest spoilage to different degrees. Initial quality of the product determines to a great extent the keeping quality. Produce free of mechanical injuries, microbial contamination are less affected. Storage temperature and relative humidity (RH) are the factors that govern the activity of microbes. These along with storage atmosphere affect the quality of the stored product. Certain varieties of apple develop brown core when stored at 0°C. but not at 4° C. Low RH is less favourable for microbial activity particularly

in storage of grain crops. A controlled atmosphere with 3 per cent oxygen and 2 to 5 per cent carbon dioxide doubles the storage life.

Future strategies to combat post harvest spoilage

The brief review presented above was mainly to create national awareness of the problems of plant protection with special reference to harvest and post harvest management to combat the losses which are evidently available by human effort.

Since pest and disease management is a philosophy and the methodology of restricting the pest and pathogens to minimum non-injurious levels but not seeking total eradication, the ultimate object is to maximise cost benefit relation while minimising environmental degradation. It is therefore relevant now at the threshhold of 21st century to emphasise the need for focussing the importance of control of harvest and post harvest diseases as the primary components of integrated pest/disease management programme as an effort to solve the problems of hunger and malnurtrition of mankind in the future years to come.

Future research needs

1. Information on the extent of spoilage of various commodities is utterly meagre and calls for a detailed survey to get precise estimation.
2. Screening and locating materials which are inherently resistant to such things as grain molds, less favourable for toxin production and possessing high keeping quality.
3. Evolving suitable cultural and agronomic practices that result in toning up the initial quality of the products.

4. Assessing various pretreatment procedures and developing favourable controlled atmosphere in storge.
5. Development of equipments that help reduce injury during harvest, process, transportation etc.

Programme implementation

Development of programme for the control of harvest and post harvest diseases involves individuals and institutions at the farm as well as centralised undertaking/ agency levels.

The thrust at farmers level should be on such cultural practices that would minimise the inoculum load on marketable product, help reduce spoilage. To quote a few, avoidence of wet periods at harvesting by adjusting sowing date, harvesting at physiological maturity, bringing down the moisture content to safe limits, avoiding injuries and proper storage.

The state agency can take care of prescribing initial quality, providing wherever possible cold storage or controlled atmosphere, centralised chemical treatment and heat treatment, standard methods of packaging and storing in addition to regular inspections.

"POULTRY INDUSTRY" ITS SCOPE AND PROSPECTS IN THE 21ST CENTURY

B. S. RAMAPPA and G. R. LOKNATH

Poultry industry encompasses two broad aspects namely, layer and broiler enterprises. The multiplication of superior strains for producing more eggs and meat must commensurate with the demand for eggs and meat. Keeping in mind the recommendations of the NRC and ICMR. Though some noteworthy progress has been made, there is a long way to go from the current per capita consumption of 19 eggs to 180 eggs and from 150 g of poultry meat to 20 kg per annum. Therefore the present day poultry industry has to grow at least by about 10 times, if the minimum requirement of half an egg per person per day is to be achieved.

Breeding programmes

In view of the financial stringency and restriction imposed on the importation of birds, it is utmost important to develop our own grand parent and parent stocks so as to produce commercial layers and broiler type chickens. Many government agencies as well as private sectors have made reasonable progress in this direction and it is most satisfactory to stress once again that the layers and broilers available in India compare fairly well with their western counterparts. Consequently, franchise hatcheries have sprung up in almost each and every part of India showing a three-fold increase from 1979 to 1985. It is expected that this figure will more than double up by the end of this century.

The present day trends in preference among th broiler varieties has been for the coloured broil varieties especially in Karnataka, Andhra, Tamil Nad West Bengal and Maharashtra. These broilers shou have faster rate of growth, high feed conversion effic ency and high rate of survivability. Research effor oriented towards developing this strain of broiler variet at the Department of Poultry Science, University o Agricultural Sciences, Bangalore have been very successfu The birds so developed have the added advantage o resembling the local desi fowl with regard to the plumag colour in addition to having higher rate of growth better feed conversion efficiency, disease resistance an higher egg production than the local desi birds. The are in high demand due to their popularity among th villagers.

Another important problem that is to be tackled i the nearest future is the development of strains resis tant to the common poultry diseases, such as avia leukosis, mareks coccidiosis and gumboro. It has bee experienced that strains with high potentiality for growt and egg production have shown less resistance to th above mentioned diseases. Though they can be tackle through efficient management practices to a moderat extent, permanent solution is only through the appli cation of genetic principles. This aspect is the majo factor that is to be probed in depth in the near future

Feeding programme

Feed constitutes the major part in poultry productio (70 to 75 per cent). Due to improper management of lan resources, cost of the commonly used feed ingredient and also their non-availability, profit realised fro poultry industry has become limited and at times non profitable. However, this problem has been takcled t

a lesser degree by utilising cheaper feeds and their bye-products without affecting the minimum nutrient requirements such as protein and energy as well as the quality of the feed provided.

Efforts must be made to maximise profitability by identifying the following factors :

(i) Marketing of the feed ingredients available

(ii) Standardising the quality

(iii) Improving the quality of ingredients

(iv) Maximising the nutrient economy and energy

(v) Finding newer sources of protein and energy

1. Availability of feed ingredients is always less than what it could be due to the export policy of the Government and also manipulative tactics to the industry. Therefore, a revised policy of the Government and also a healthy industry should make easy the availability of commonly used feed ingredients such as maize, groundnut meal and brans.

2. A legislation should be passed by the Government to declare the quality of feed ingredients marketed based on the reports from central laboratories such as I. S. I. etc.

3. The major problem affecting the quality of feed ingredients is from aflatoxins which limit the production potential of brids. There are tannin, goitrogen erucic acid, recin, gossypol, cyclopropenoid fatty acid and other unidentified toxic factors. Detoxification is possible only against a few toxins. Therefore, a lot of concerted efforts must be made to minimise the danger from all toxins by setting up investigating research laboratories for identifying all toxins in the common feed ingredients.

4. Nutrient requirements vary from strain to strain. Therefore, efforts must be made to identify factors so as to ensure the right nutrient requirements for optimum production. Much work has to be done on the requirements of protein, energy and amino acid under varying conditions. The most important aspect is to make research efforts for balancing the protein energy ratios.

5. It is feared that in the near future, the commonly used feed igredients available today may not be available in the near future. Therefore, alternative cheaper feed materials ensuring good quality and free of aflatoxins must be identified. In this direction, the use of single cell protein organism growing on wastes and capable of absorbing solar energy may be helpful.

Management and disease control programmes

The last two decades have witnessed a total transformation of rearing poultry from backyard farming to semi-intensive and intensive methods. Presently, cage system of rearing is being practiced. The reason behind this transformation is to maximise profit by economising floor/space requirement per bird, which enables to increase the stock density per area.

Another revolutionary step under deep litter systems of management is by recycling of the deep litter. Efforts in this direction have been made by the Department of Poultry Science, UAS, Hebbal, suggesting that once used broiler litter (disease free) may be further used to raise fresh broiler stocks to promote growth and feed efficiency without affecting the viability. This will not only help in meeting more economic returns per bird raised, but also minimise the expenditure incurred in procuring fresh litter material.

Production from poultry can be intensified to maximise profit only when the diseases are kept under complete control. During the last two years, there has been anupsurge in the occurrence of common poultry diseases as well as new emerging diseases, perhaps due to low resistance level caused due to physiological changes. In order to maximise profit, birds undergo production and managemental stresses, thus resulting in metabolic deficiency, infections and toxic diseases. Due to possible changes in ecology, new diseases have been recorded. Therefore, the following aspects must be given proper attention to control poultry diseases :

1. Education of farmers on scientific management and adoption of hygenic measures.
2. Ensuring proper supply of balanced feed.
3. Establishment of diagnostic laboratories, and
4. Elaborate arrangements for production and testing of preventive vaccines against emerging diseases.

Most of these aspects have been paid rapid attention already. The last item needs thorough application and has to be intensified in the near future.

Technology and marketing programmes

Commensurate with increased production of poultry products, proper channels should be created for complete disposal of poultry products without affecting their quality. At the same time, consumer acceptance and consciousness must be ensured. Poultry products technology has not received much attention that it deserves, possibly because the gap still exists between requirement and supply. At present, two institutions namely CFTRI, Mysore and CARI, Izatnagar, have done some commendable work in the preservation of eggs and their bye-products

such as egg powder, egg pickles, egg albumen flakes, yolk powder, frozen yolk, etc. Attempts also have been made to preserve chicken meat for the preparation of barbecue chicken, cured and smoked chicken, chicken sandwich, chicken essence, sausage, canned chicken etc. However, new packaging practices must be developed. Each State should establish cold storages and Marketing Corporations to ensure the availability of poultry products throughout the year. Such sub-centres must also be established at rural levels such that the products are within the easy reach of rural people. As far as possible, the marketing of the products should be effected through the cooperative societies avoiding middle men such that the producers get a fair share for their products and the consumers get quality products at reasonable cost.

Extension programme

Poultry education must feature in broad casting programmes through radio and television at least once in a fortnight. These facilities must be preferentially centered around important rural areas. Programmes such as field trials and demonstrations as well as lab-to-land programme must be regularly organised. Similarly, Krishi Melas must be given importance. Farmers Training Institutions must organise a short term training programme on different aspects of poultry rearing.

The motto for the 21st Century should be "LET CHICKENS SAVE MAN AND LET US STRIVE TO ACHIEVE ALL OUR GOALS UNITEDLY".

USE OF PLANTS AS RENEWABLE ENERGY SOURCES IN 21st CENTURY

Y. C. PANCHAL

Photosynthesis is the best light converting process for the production of organic matter and all living things are dependent on the sun and ultimately on the green plant. We, people depending on plants for food and fibre have also to depend upon for current energy requirements *i.e.*, the hydro-carbon producing plants (hydrocarbons are the richest chemical energy forms). Biomass currently contributes about 25 per cent of the world's energy equivalent to about 20 million barrels of oil per day. Green plants utilse hardly one per cent of the solar radiation and 99 per cent of it is lost as heat. Each second the sun sends into space an energy equivalent to one million times that of the earth fossil energy *i.e.*, coal, natural gas, petroleum products, tapped by the man. It is the plants that can use CO_2, water and solar radiation and convert to chemical energy.

Hybrocarbons from the plants

1. *Sugarcane :* These plants have effective energy converters but convert most of it to carbohydrates. Juice is fermented into alcohol for liquid fuel (though it is not as good as hydrocarbon). Brazil which has the highest sugarcane area besides producing 70 million mt of raw sugar is also producing 5.3 billion litres of alcohol by the use of autonomous alcohol producing units.

2. *Hevea brasiliensis* (rubber tree) : It belongs to the family of Euphorbiaceae, and has 2000 different species growing in different climates of the world. All Euphorbias contain a latex which is an emulsion of 1/3rd oil in water. The hydrocarbons in the Euphorbias is a molecule with a lower

molecular weight than the hydrocarbons in the rubber tree. The oil extracted from various species of Euphorbia looks, feels and behaves like crude oil.

3. *Euphorbia lathyris* and *E. tirucalli :* These plants are grown on experimental scale in California for oil production.

4 *Asclepias* (milk weed) : It belongs to the family of Asclepiadaceae and is a better candidate than Euphorbaceae, since plants are hardier and can grown in colder and drier climates.

5. *Calotropis procera* also belong to the Asclepidaceae and is largely grown in Australia.

Both *E. lathyris and Asclepias,* on 100 mt/day basis produce 80 mt of oil (by solvent extraction) and the residue is extracted with methanol-water to remove fermentables, giving 200 mt of sugar as well (which is equivalent to 100 mt of alcohol) and bagasse is used for burning purposes and hence economically attractive. Euphorbias and Asclepias contain some fats but mostly steriodial, cyclic hydrocarbons with 30 carbon atoms. They can be cracked into crude oil.

6. *Seed oils :* Soyabean, sunflower, safflower, cotton seed and rape seed oils are being thought of possible source of fuel particularly diesel fuel, because these triglycerides can be directly used as diesel fuel by farm machinery.

7. *Eucalyptus :* Seeds contain terpene like oils.

8. *Pittospor-um-undulatum* and *P. resiniferum,* the fruits contain oil (containing terpenes and pinenes and myrcene), Fruits called Hanga are burnt like torches in Philippines.

9. Conpifera langederfii and C. maltrijuga, commonly grown in Brazil and can produce 25 litres of oil in 24 hours. Oil is drained out twice in a year and can be directly used in a diesel engine without any further processing.

10. Algae as hydrocarbon producers: Colonial green alga (Botryococcus brunil). It occurs in many parts of the world, primarily in fresh waters. Colonies are often observed floating on the surface of undisturbed waters. The buyoancy is due to the large amount of accumulated oil in the alga. It is reported that algae yields about 70 per cent of its dry weight as oil but typical range is from 25 to 40 per cent. The hexane extracted protryoceccus oil is of orange colour, due to carotenoids. After removal of pigments, a clean oil is obtained. It contains homologous series of unusual isoprenoids. Now C_{34} compound named Botryococcene and C_{36} compound as Darwinene have been reported. Experiments are in progress in Australia and USA for its commercial exploitation.

The compounds from the Euphorbias, Aselepias, Eucalyptus, Pittosporum, Coparifera and even Botrycoccus are all related to each other through the pathway of terpernoid biosynthesis in plants. These oils are entirely of terpenes containing 15 carbon atoms (about 25 different kinds with cyclic C_{15} materials).

The idea that the plants may be used as a source of hydrocarbon like materials as substitute for petroleum and derivedchemicals will be more important, especially in the less developed countries of the world where land is unsuitable for food production. We, the agricultural scientists have to provide the technological guidance for cultivation of high yielding species and extraction methods. The agricultural community has to commit itself to an energy-agriculture, which would have long term benefits using annually renewable green plant for the world's benefit.

REFORMS IN AGRICULTURAL MARKETING

P. G. CHENGAPPA and S. V. PATIL

The development and introduction of high yielding varieties and the associated cultural practices helped to bring about green revolution in the country. To sustain this yield-dominent agricultural development, proper agricultural marketing infrastructure and remunerative prices for farm produce are crucial. Remunerative prices could act as great catalysts for agricultural development in association with new technology. The agricultural marketing system which is largely in the hands of middlemen and other private market intermediaries favours more profits to those people at the cost of farmers. The farmers' share in consumers' rupee is quite often low, if one observes hard work which farmers have to put in and the production risks which farmers face. This situation of inadequate marketing infrastructure and lower returns to farmers would definitely dampen agricultural development process and thereby general economic development of the country. This explains the measures which the developed countries have taken to build appropriate agricultural marketing institutions which in turn have strengthened their farm base. This note is an attempt to discuss in broad terms the structure of agricultural marketing appropriate for our environment.

With all the problems facing cooperative marketing system, there does not seem to be a better alternative. The farmers' co-operatives with active participation of their members could safeguard their economic interests by avoiding exploitation by other agencies. The organisation of cooperative milk units in Gujarat and other states provides a good example of what cooperative organisations could do for increasing production, for ensuring reasonable returns to farmers and for making good quality milk available to consumers at reasonable

prices. The same approach is being followed in some areas in the case of oilseed marketing. In this country, we have the experience of organising Coffee, Tea and Rubber Boards to safeguard the interests of farmers. The questions that require critical assessment are whether similar type of organisations (with modifications) could be built for some major products and what are the basic factors that are involved in developing this kind of market organisations.

—Any agricultural marketing system that is to be evolved should have an active participation of farmers.

—Establishing grade standards on more scientific lines and providing facilities for grading at market centres so that the quality goods can get better price.

—As indicated earlier, cooperative system of marketing does not have any proper alternative institutional system, so the working of cooperative marketing system should be streamlined, to include almost all components of marketing such as assembling, processing, packing and storage linked with adequate amount of credit. Further, this system should be supported with market intelligence and R & D back up. All these components of an effective marketing system should be decentralised, as much as possible, so that the region-specific requirements are met.

—In evolving a comprehensive agricultural marketing system like the one indicated above, a cadre of trained manpower should be involved in organisinc and effective management.

—The primary units at Mandal level could be pooled into a Federation for larger operations including export of agricultural products.

In many countries that have attained high level of agricultural progress, there are Boards like Wheat Board, Cotton

Board, Tobacco Board, etc., organised on the lines indicated above. So, we have reached a stage in our agricultural development, where the organisation of the Boards of this kind has become imminent. The State of Karnataka may make a beginning in the direction of organisation of Boards for Chillies, Onion, Potato, Tobacco and Cotton, and other crops could be covered in course of time. Some effective beginning on all these lines could provide an accelerated path for agricultural development and welfare of rural people.

INTEGRATION OF INPUT AND OUTPUT MARKETING

T. P. GOPALASWAMY

The infrastructure which has been developed over a period has been taken full advantage of by firms engaged in manufacture, supply and distribution of inputs. The same infrastructure arrangements must be utilized profitably for output marketing also. Regarding infrastructure development, what has happened in our country is exactly the opposite of the objectives with which they are established. A case in point is the establishment of Central and State Warehousing Corporations. These warehouses were established on the recommendations of the Rural Credit Survey Committee Report.

Marketing revolution needed

Twenty first century must witness a revolution in marketing of agricultural produce. This alone will help in sustaining the technological breakthrough like green revolution. The green revolution has made the country more than self sufficient in the requirement of foodgrains. Similar revolutions can be reasonably expected to occur by the 21st century in the case of pulses, oil seeds and probably dryland farming. But to sustain such revolutions, the pre-condition would be an agricultural marketing revolution.

One of the main requirements for such a marketing revolution is a "form of organization" for the farmers, wherein the farmers of similar interests could get together. There is a model in operation in the country, which has been mostly successful, and successfully replicated in the form of 'AMUL' pattern dairy cooperative societies in rural areas. This is similar to the 'Single window concept' adopted for industrial growth. The Dairy Cooperative Society becomes the focal point for a farmer wherein he gets all the inputs required for

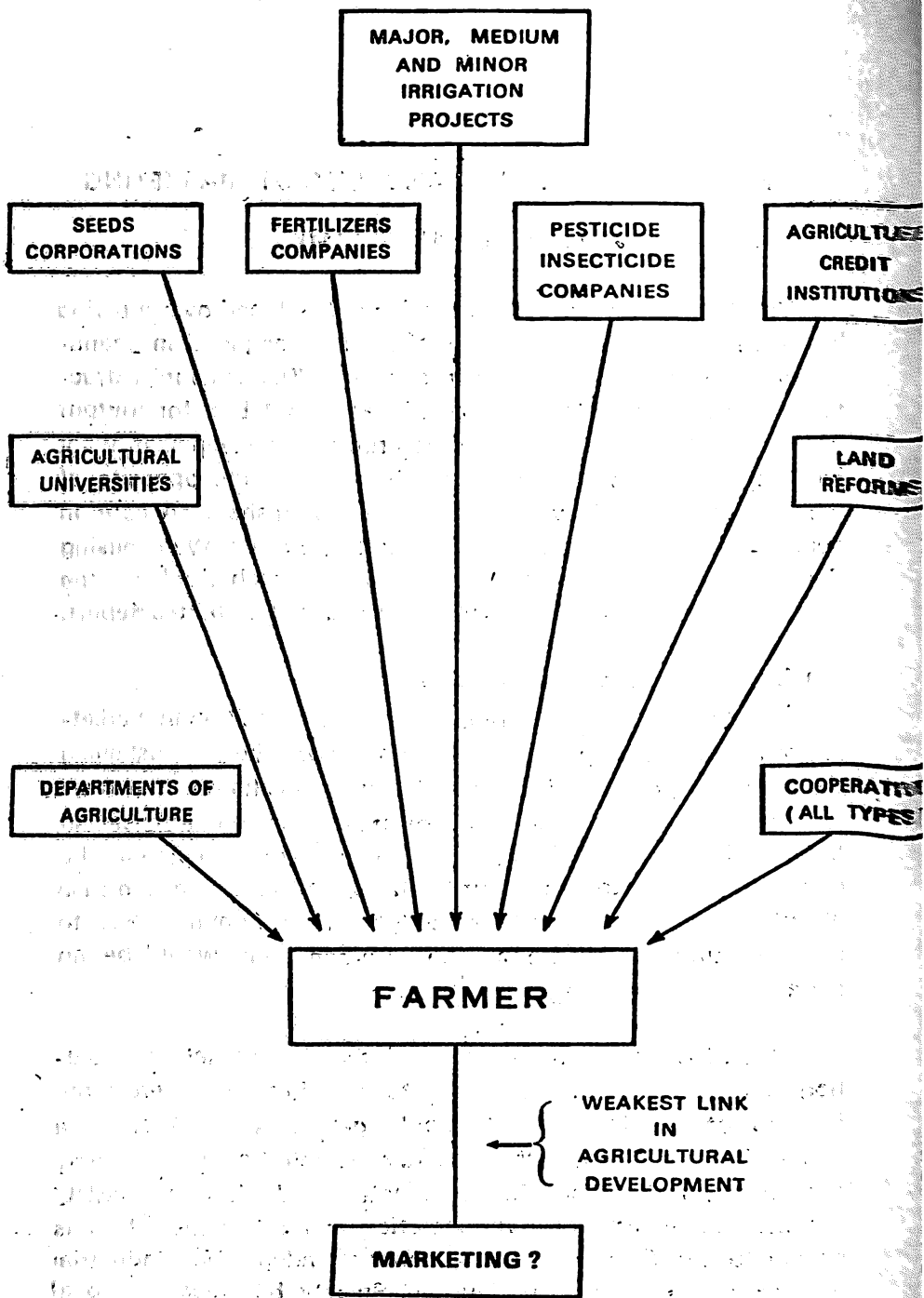


Fig. 1. Situation of Farmer

dairy farming and he sells his output. The success of this model has given to impetus to extend the same concept to vegetable oil seeds like groundnut, etc. In addition; since these activities are organised on cooperative basis, the producers naturally get linked to the State Level Federations through the district level unions. These federations have the necessary marketing clout to undertake the responsibility of manufacturing and marketing the types of products in demand. Thus the value added to the raw material in processing stays within the organisation enabling a better share to the farmer in the consumer's rupee.

Amul Pattern Dairy Co-operative structure referred has also processing activities in-built in the system. In the absence of processing facilities, it is doubtful whether the model could have been a success. Hence the second requirement in the marketing revolution is "processing facilities" with farmers' direct or indirect participation. The processing facilities may at least be up to primary or secondary processing, if not up to the end product stage. This will go a along way in ensuring the farmers getting a fair share of the value added to the agricultural produce.

Yet another requirement would be to evolve alternative uses for the agricultural produce and byproducts which will add more value to the product. Maize is an excellent example wherein it is not merely considered as a food grain. Starch production from maize is very lucrative and in addition, popcorn and corn flakes are also made out of maize. Some of these are fairly high value items. Such uses for most of the other crops are absent. There is need for doing research in these areas to find out alternative uses for the agricultural produce and also for the byproducts. Probably worst affected crops are fruits and vegetables which are normally consumed fresh.

These types of developments, if only takes place in 21st century, we may find, rice cooperatives, wheat cooperatives

like milk and oil seed cooperatives which are owned and operated by farmer producers. Thus, there are three important aspects to the marketing revolution to take place as explained in the preceding paragraphs :

— Form of organization for the farmer-producers

— Establishment of processing facilities on the farmer-producers' account.

— Evolving alternative uses for agricultural produce and byproducts.

If these three things happen, it can be hoped that there would be a marketing revolution in the twenty-first century.

MARKETING TECHNOLOGY FOR INDIAN AGRICULTURE IN 21ST CENTURY

HEMALATA M. PATIL

Neglect of marketing technology

Indian agriculture has achieved a break through. India was food deficit in 50's but now it is in a position to export. Because of application of new technology, use of high yielding varieties, increased irrigation facilities and use of fertilizers, the agricultural production increased. However, due attention was not paid to agricultural marketing technology. It is a peculiar Indian situation where the producer and consumer have nothing to do in fixing the price of the agricultural commodities. It is a middle man who fixes the price.

Co-operative marketing - ideal structure

To realise the gains of increased production the farmer should be provided by institutional marketing facilities. The co-operative marketing structure has played a significant role in developing a direct link between the producer and the consumer with an objective to avoid the middle man. At present the co-operative marketing structure consists of national federation at the national level, 29 state level co-operative marketing federations, 171 Central/District societies and 3,632 primary marketing societies. The marketing co-operatives are engaged in the activities of marketing and storage of agriculture produce, supply of agricultural equipment and supply of essential consumer articles. The turnover of the marketing co-operative on these three counts has reached Rs. 2,500 crore in 1984-85.

The National Agriculture Co-operative Marketing Federation of India has continued to play an important role in the price support operation of various agricultural commodities and

achieved business turnover of Rs. 113 crore in 1983-84 by implementing the Government Canalization policy for the export of onion, HPS groundnut, sesame seed and also canalised the import of fresh fruits etc. Its export during 1983-84 reached Rs. 51.17 crore.

The co-operative movement has made remarkable progress in the sphere of processing of agricultural produce in raising the number of processing societies to the level of 2458 in the country, in the field of cooperative processing. The production of sugar in the co-operative sector accounts for 56 per cent of the total sugar produced in the country.

Another important segment of cooperative processing sector is cooperative spinning mills. Their utilization of spindleage was above 80 per cent in 1983-84.

One of the most important trends that has taken place in the sector of cooperative processing is its further diversification. With the increased emphasis on oilseed production, co-operative oilseed processing activity was sponsored. Foreign collaboration for this activity was established between Indian Co-operative Movement and Cooperative League of USA.

At the beginning of sixth plan, the total storage capacity in the cooperative sector was 47 lakh tonnes. To strengthen this capacity further, the National Cooperative Development Corporation initiated a massive programme of construction of 20,000 godowns with storage capacity of 37 lakh tonnes in 10 states with assistance from World Bank and European Economic Community.

The quantum of fertilizers handled by cooperatives during 1983-84 is estimated at 33.75 lakh tonnes (Nutrients) representing about 43 per cent of total fertilizer consumption in the country.

An elaborate system of providing extension and other services to farmers developed by IFFCO has been a model for

the fertilizer manufacturers in the public and private sectors. It also set up a Cooperative Rural Development Trust of promoting professional leadership and training the progressive farmers through the Moti Lal Nehru Farmers Training Institute, Phulpur. It has also established a Fertilizer Marketing Development Institute at Gurgoan for giving inservice training to its own staff and officers as also functionaries of cooperatives.

Strategy for effective cooperative structure

The marketing cooperatives in India, however, are suffering from certain organizational, managerial, structural, financial and operational problems. They have yet to build the professionalism.

To tackle the situation in 21st century, the cooperatives must develop processing and storage facilities. They have to have strong capital base, professional management and well trained technical personnel. They will also have to have innovative leadership characterised by commitment.

1. Every primary marketing society should bring all the farmers families who have marketable surplus within its fold, within the period of five years.

2. Primary marketing societies should give guidelines in preparation of short term plans as well as long term plans in respect of commodities marketing, storage, processing and distribution of inputs.

3. The apex federation should actively collaborate with the Apex Consumer Federation and Primary Marketing Societies should establish close contact with district wholesale consumer store.

4. At the national level long term commoditywise marketing plans should be prepared.

5. The state federation should act as a stockist for distribution of fertilizers and other agricultural inputs while the marketing societies should perform the function of distribution.

6. The federations must restrict their activities only to wholesale level and must not compete with primaries by undertaking retailing.

Key factor service

Mere increase in the production does not improve the economic conditions of the farmer. In fact marketing technology must preceed production technology. It is only the effective marketing structure that can come to the rescue of the farmer. And here the cooperative marketing is the only way to provide an institutional arrangement to solve the marketing problem of the farmer.

In future the marketing cooperative will operate in competition and control. In this future situation the effectiveness of marketing cooperatives depends upon their efficiency, productivity and service.

It is the service giving of the cooperatives that determines their relevancy to the situation in future.

Marketing is a professional job. Therefore, the cooperatives will have to inject the professionalization in management. Therefore, given the committed leadership, professional management and enlightened members, the marketing cooperatives can handle the marketing problems of Indian agriculture in coming decades.

PROSPECTS OF EXPORTING HORTICULTURAL CROPS— PLAUSIBLE STRATEGIES FOR THE 21st CENTURY

N. NAGARAJ, SHIVANANDA, M.G. CHANDRAKANTH and R. RAMANNA

In this note we make a modest attempt[1] in futurising the export potentials[2] of selected key horticultural crops for the 21st century and list plausible strategies necessary in tackling the emerging trade problems.

I. Beverages

1. *Tea :* The Tea bushes in about 40 per cent of the total area (3.6 lakh ha.) are over 50 years of agriculture. The projected export potential for tea by the turn of this century is around 2,30,000 tonnes. To reap this benefit, there is a need for scientific replanting programme. The export of tea in black leaf bulk forms around 80 per cent of the total value of tea exports, which is a pointer to the slow efforts made towards exporting packaged tea and instant tea. Hence product diversification is the key for the success in export market. The industry should utilise the government facility of interest free loan up to 50 per cent of the cost of brand promotion of packaged tea in export markets to develop the industry.

2. *Coffee :* Since the early seventies, India has been exporting about half of its production of coffee. Indian coffee is exported to the U.K. USSR, West-Germany, U S.A., Belgium, France, Italy, Australia and Kuwait. The export potential of

---

1. We have employed the simple and compound growth rates of exports in projecting the potential for 2001 A D. However in certain cases, we have not hesitated making value judgements in the case of commodities, where the growth rates were unrealistic.
2. The actual exports for 1981-82 and the projected exports for 2001 A D. are presented in Table I.

TABLE I

Actual and projected exports of Horticultural commodities

	Commodity	Projected Exports by 2001 AD (Tonnes)	Actual Exports 81-82 (Tonnes)
1.	Mango (fresh fruits)	18000	7483
2.	Pineapple ,,	2000	896
3.	Apple ,,	13000	3619
4.	Grapes ,,	2000	1050
5.	Banana ,,	2000	146
6.	Oranges ,,	23000	7124
7.	Lemons and limes	420	93
8.	Tamarind ,,	3000	241
9.	Tamarind (Dry)	35000	2653
10.	Onions (Fresh)	430000	169000
11.	Potatoes ,,	15000	5000
12.	Coffee	160000	81220
13.	Tea	230000	210000
14.	Cardamom	8000	2325
15.	Pepper	60000	20608
16.	Chillies	20000	4000
17.	Ginger	24000	11200
18.	Turmeric	14000	11900
19.	Cashew	15000	31500

coffee would be around 1,60,000 tonnes by 2001 A.D. Our exports have been fluctuating, though the growth rate of domestic consumption is lower than that of exports. Being a member of ICA, India has to remain an important and consistent exporting country.

II. Spices

Indian spices occupy a unique position in the world trade of spices standing for vigour, aroma, excellent quality and penetrating flavour earning around Rs. 130 crores of exchange.

1. *Pepper :* Though India exports nearly 80 per cent of its total production, its share in the international market is only around 18 per cent. Our main importing countries are middle-east, USA and USSR. The export potential of this crop by the turn of this century is around 60,000 tonnes.

2. *Cardamom :* The current world production of cardamom is around 8,000 tonnes of which India's contribution is around 56 per cent and its share in the world's export is around 26 per cent. The country has lost considerable trade prospects in cardamom in West Europe due to entry of Guatemala and other West European countries. The prospects of export for 2001 A.D. would be around 8,000 tonnes of different types of cardamom.

3. *Chillies :* Being the biggest producer and consumer of chillies, India's share in world exports is around 4 per cent. The future export prospect would be around 20,000 tonnes by 2001 A.D. The need to popularise chillies is due to potential for consumer demand from West, regarding the South Indian dishes using chilli powder.

4. *Ginger :* India is the largest producer of ginger producing half the world output, and ginger is the third largest foreign exchange earner among spices next to pepper and cardamom, exporting around 9000 tonnes (12 per cent of its production) to East African and West European countries. The export potential of ginger will be around 24,000 tonnes by 2001 A.D.

5. *Turmeric :* India is the World's biggest producer and exporter of turmeric exporting to Iran, USA, Japan, UK, Libya, Singapore and Canada. Indian turmeric earns a premium price for its superiority in the world market. The prospects for export would be around 14,000 tonnes by 2001 A.D. This low potential is due to its low domestic production itself (which is around 12,000 tonnes).

III. Fruits

1. Mango : Mango constitutes a major item of export among fresh fruits. The world production of mangoes is around 140 lakh tonnes of which India's share is around 65 per cent. There is an immense potential for export of mangoes to countries like Singapore, Malaysia, the Gulf and European countries. The Alphanso (Badam) variety forms almost 60 per cent of the exports of fresh mango. The prospect of exporting mangoes for 20001 A.D. would be around 18,000 tonnes.

2. Pineapple : India produces around 8 per cent of the World's production of 90 lakh tonnes. The potential for exporting fresh fruits is around 2000 tonnes by the turn of the century.

3. Apple : The exports from the country account around 0.5 per cent of its production of 10 lakh tonnes. The export prospect for 20001 A.D. would be around 13,000 tonnes of fresh apples.

4. Grape : The world production is around 716 lakh tonnes of which India's share is around 2.5 lakh tonnes. The exports from India constitute just 0.5 per cent of its total output. The export potential for 2001 AD would be around 2000 tonnes for table grapes. In the temperate continents, there is considerable demand for processed grapes in the form of grape wine.

5. Banana : India's share in world banana output of 41 akh tonnes is 11 per cent and it exports around 5 per cent of its production. The export potential for 2001 A.D. would be around 2000 tonnes.

6. Orange, Lemon and Lime : India exports 7500 tonnes of oranges. The export potential for oranges is around 23,000 tonnes and for lemons and limes it would be 420 tonnes. Singapore, Malaysia and Hongkong are the potential markets that could be tapped.

7. Tamarind : India is the largest producer and consumer of tamarind. It has been exporting an appreciable quantity of dried tamarind over the years. The prospect of export is around 35,000 tonnes of tamarind and 2,000 tonnes of fresh tamarind by 2001 A.D.

8. Cashew : India enjoys a comparative advantage in both production and processing cashew due to the favourable climate and availability of skilled human labour in processing. In the recent years, the entry of Mozambique and Brazil in the world market with their expanding processing sector has amply exposed the Indian *foot loose* cashew export policies. The export potential for 2001 A.D. would be around 19,000 tonnes which is half the actual exports of 1982.

IV. Vegetables

1. Onion : The country produces around 12 per cent of the world's output (225 lakh tonnes) and exports around 6 per cent of the domestic output. The efforts towards exports should concentrate on countries like Singapore, Malaysia, Sri Lanka and European markets. By 2001 A.D. the export prospect would be around 4,50,000 tonnes.

2. Potato : The European countries account for more than 70 per cent of the world's output of 2550 lakh tonnes, and India's share is just around 4 per cent. The export potential for 2001 AD would be around 15,000 tonnes.

3. Other vegetables : The prospect for exporting cauliflower are bright in Malaysia, Singapore and Kuwait. The export potential is around 100 tonnes by 2001 AD. Regarding cabbage, the potential is around 1000 tonnes.

Plausible strategies: 1. Even today, fresh fruits constitute a largely neglected group of exports from India, showing erratic trend in exports. It is necessary to organise export trade of tropical fruits to enable to export at competitive rates in the world market. This includes, creation of infrastructure for

supply of necessary inputs, services and knowhow, marketing and processing facilities, the development of growers cooperatives and mooting a price support scheme.

2. Hardly one per cent of production of fruits and vegetables is used by preservation industry and 25 to 30 per cent of perishables go waste in stages of picking, packing, transporting and selling. There is a need to develop processing industry to prevent such wastages.

3. It is necessary to frame a long term export policy earmarking certain proportion of production for exports every year to infuse confidence among importers.

4. In addition to the export of wholesome cardamom, India should venture to distil and export cardamom oil by using sub-standard, quality of cardamom. There is a need to explore the possibility of exporting instant cardamom coffee and instant cardamom tea in consumer packs to the middle east after studying their consumption habits.

PRICE POLICY FOR AGRICULTURAL PRODUCE AND ARRANGEMENT FOR PURCHASING THROUGHOUT THE YEAR

V. S. HIREGOUDAR

Indian agriculture is in a transitional stage at present. It is no longer a way of life but is developing as a form of commercial business. The farmers have accepted and adopted the improved methods of farming and help for increased production. The farmer today, is purchasing seed, fertilizer, pesticides etc. from the market. Because of intensive monotisation the farmer is borrowing from the Banks and other sources at high rate of interest. All these factors have led the farmers to enter into greater liability year after year. The modern tachnology being highly capital intensive, borrowed investment has turned to be inevitable, in the present development stage.

The agricultural planning in India today, it should be observed, that it is not scientific so far as it does not take the basic natural factors such as agro-climatic conditions, into consideration. The Agricultural Planning ought to be on regional watershed basis as in Japan and elsewhere. So also the farmer who is the instrument of farm operation is overlooked in the involvement of planning process. The market situation and the price for farm produce is much more disappointing. All that is said and done, is a mere exercise of experts in pointing out the scarcity and fixing up of corresponding targets. The policy making authorities both in the Government and the Planning Commission have not given due consideration to the question of crop planning and the economy of the millions of farmers engaged in farming enterprise. Therefore regional crop planning and the role of prices

of the farm inputs and outputs assumes great importance in agricultural planning and future development of agriculture. The first and the foremost thing is to deem farming as an economic activity or 'primary industry'.

The moot point in farm economy today is fixing up of remunerative price to agricultural produce and stabilisation of the same. It should be settled by Government by suitable measures to eliminate the 'middleman' who is exploiting the steady increasing national economy and bring justice to the producer as well as the consumer. Direct purchase from the producers and distribution would certainly hold the priceline. The main question that arises is should the price determination be left to the operation of the market mechanism ? or Should the Government undertake the responsibility to regulate or determine the prices ? In India, there is no getting away from state intervention in agricultural pricing. It is, because, there is invariably a gap between the requirement and availability of consumer goods and if the things are left to the market forces, the private trader have a tendency to exploit the situation to their advantage and to the detriment of both the producer and consumer.

Many of the 'adhoc' measures of the state from time to time have ended in fiasco, *e.g.* wholesale trading in wheat, 'Free Market Price' and 'statutory price' of the same products such as sugar and foodgrains etc. have not yielded the expected results. If the consumer demands is to be satisfied and if economic development is not to be impeded by inflation in food prices or importation of food, the 'Agricultural Marketing System' should be able to meet the challenge of moving adequate quantity at minimum cost and organise its distribution in such a way as to fully meet the consumer demand. The development of such marketing system is the need of the day and the test of a progressive marketing policy.

Customarily, 'Agricultural Markets' in India can be broadly classified into 3 groups - Hats and Shandies, retail markets

wholesale markets. These markets are served by several types of middlemen. Although the sellers and buyers in these markets are large in number, purchases are made under conditions of imperfect competition and usually the small producers because of their weak bargaining power are compelled to sell their produce at distress rates. That is how the average farmer is subjected to constant exploitation and deprived of the profits of progress.

It is true that the establishment of 'Regulated Markets' have contributed to the development of orderly 'Market Yards' but the object of eliminating the malpractices is far from satisfactory. Excess and objectionable charges are continued to be collected from the farmers in the market, is a open secret. The socalled No. 2 Account trading is going on with the knowledge of the A.P.M.C. authorities. So also, wherever strong Marketing Cooperatives have developed, private trade behaves better and can be disciplined with ease. Marketing Cooperatives have turned to be mere alternatives to commission agencies. All the same, they cannot be expected to have enough bearing on the market price. The question still remains as to who can purchase offering remunerative price to the farm produce in the market, next to private traders?

The one and the only marketing policy to correct the imperfections arising from the monopolystic activities of the private trade can take the form of direct involvement of the Government at the national level and state or regional levels, with a view to securing effective competition. What is required is a catographic picture for each major commodity, showing the strategic or most important assembly markets and collection areas within each production zone and to depict the main channel through which the produce flows to reach the final urban consumer markets or export markets. Such a flow-pattern map can possibly provide adequate data for setting up special equilibrium for the rationalisation of distribution process, which would help reduce the marketing costs and

improve marketing efficiency. It can also be used as important planning tool for seting and construction of new markets. Thus it would be possible to cover the entire country with efficient marketing organsation.

In this context, the 'Agricultural Marketing Act' of U. K. and different commodity Boards (Wheat Board, Wool Board, Milk Board etc.) in Australia would be worth considering. Such legislation and establishment of statutory boards with some modifications to suit Indian conditions would be permanent marketing agencies at the state and national level. This sort of agencies would be able to stabilise market prices, still allowing private agencies to operate in competition. It is to be noted that the some agencies could help to export surplus goods in the proper form to foreign markets. To be brief, there should be one suitable agency at the village level, one at the tahsil or Mandi level and one of the State level, of the state statutory Board. A federated body at the national level would be formed, so as to strike an equilibrium national price and arrange for internal supplies, and advice and deal with imports and exports of farm produce. Such 'Apex Board' would provide a purchasing facility to the farmer throughout the year. In a vast country like India, having different agro-climatic regions and major area being under rainfed cropping, it is very difficult to draw a single rate for a commodity. The A.P.C. has been facing the problem and decides the prices on arbitrary basis, which are not acceptable to the farmers, being usually lower than their expectations. Mere cost of production approach is no good, since farm economy is farm family economy. To develop farming as an enterprise or industry, it has got to be made remunerative the farm family. The N.C.A. has suggested that index number of parity prices received and prices paid by the farmer both for domestic and farm expenses be constructed, so that a watch can be kept on the behaviour of the parity and remedical measures taken whenever parity goes unduly against the farmers. This parity formula if worked

honestly for a given period would surely indicate the realistic price for the farmers in the long run and help the Government to take up suitable remedial measures, so as to keep up farming business on economic lines. It would also be convincing to the public at large and bestow justice to all sectors of society. The prices so fixed may vary in a reasonable margin from state to state, or region to region, within limits of distance to cover the transportation of goods. This has got to be accepted in the true nature of things.

The main points for fixing up the prices would be 1) State wise cost estimations for all the important crops, 2) Costing of inputs on the basis of actual paid out expenses on an average, 3) Imputed rental values for owned land, 4) Family labour and hired labour, 5) Working capital invested along with owned fixed capital investment and interest thereon, 6) Mangaerial any supervisory charges, 7) Risk bearing allowances or the insurance cost, 8) Preparatory and post-harvest expenses including storage and marketing charges and 9) Marginal profit of at least 20 per cent. The price thus fixed would be reasonable and would be remunerative and acceptable to farmers.

To sum up, it should be noted that agricultural price problem is not merely cost of production but is a net farm income problem, on parity price in other sectors of society, which Indicates the well-being of the farmers and ensure their continuity in farming business. Taking into consideration, the small holdings in India and the large population engaged in the field, at once, it appears both to be individual and national issue. As such, it is to be taken on top priority without yielding to the vested interests in trade and industry as well as the political influences. Strictly scientific and economic considerations should be the basis for evolving a suitable marketing agency, so as to provide a permanent marketing channel to farm produce and to fix up the prices at proper incentive levels.

PERSPECTIVES IN AGRICULTURAL MARKETING— OBJECTIVES AND LEGAL FRAMEWORK

H. S. GOPALA RAO and A. MAHESHWARI

A major part of the 20th century has been characterised by shortage in agricultural production. It is only from the eighties that we are able to turn the corner and have surpluses. The twentyfirst century certainly holds out the promise of an era of abundance.

In the Sixth Five Year Plan the main thrust of Agricultural Policy has been on marketing. This will have to continue to be so in the coming decades. Hence, it is appropriate that we take a hard look at the policy of the government with respect to marketing and the legal framework within which it is to be implemented.

Objectives and Methodology

While a legal provision is not sufficient to ensure implementation of the policy, it certainly provides the basis for such implementation. The agency to implement the policy can hardly be expected to carry out what is not required of it by law. Conversely, if the policy is not matched by legislative support, it remains a platitudes

The purpose of this paper is to examine the extent to which the spelling out of a policy in the Five Year Plan is followed up with promulgating the necessary legislation so as to enable the government machinery to carry the development objective enshrined in the policy, to fruition. As important as this is the policy, should be spelt out in clear terms as also the consistence with which it is pursued in successive plans. The study seeks to examine these aspects in relation to the development of

agricultural marketing in Karnataka, as laid down in the Karnataka Agricultural Produce Marketing (Regulation) Act, (KAPM (R)) 1966.

Providing remunerative prices to agriculturists is the sine qua non of the policy of agricultural marketing. Towards this end the government employs several instruments. The following are the major ones identified in the plans :

i. Expansion of market regulation.
ii. Co-operative marketing.
iii. Providing facilitative services like grading, storage and market intelligence.
iv. Market research.

In Karnataka the expansion of regulation of marketing has been taken care of by law. Therefore, the legal provisions are examined with respect to the other aspects.

Co-operative Marketing

The First Five Year Plan itself envisaged legislative support for bringing the management of regulated markets under co-operative directions and also for making processing facilities available through them.

Except for giving representation to co-operatives on market committee, the Act is silent on other aspects. As is well known, co-operative marketing did not take roots except in certain pockets. This is so even after more than a quarter century of regulation. A legal provision entrusting the responsibility of market regulation and giving financial support to the co-operative to act as traders should be introduced. This would also strengthen the market committees in disciplining the traders, since they would have an alternative buyer in the market.

Introduction of direct sales is important in eliminating the non-functional margins of middle men, thereby reducing the m rketing costs. Surprisingly this responsibility is classified under the discretionary duties of the market committee (Sec. 63 (2) (b) (vi), thus devaluing its force and importance.

Introduction of further, prequisites of direct sales, like provision of storage and market finance are no where mentioned in the Act.

The law is equally lax with respect to grading (Sec. 63 (2) (X)). There is no element of compulsion in the law. Hence even today grading is yet to be introduced seriously in most of the markets for all the commodities except cotton and to some extent groundnut. The plans themselves mention the importance of grading for bulk handling, but the law is not adequate.

Market intelligence and market research fare no better in the Act.

The problem is made more complicated by the face that the policy itself is not consistent from one plan to another. Having raised the problem in one particular plan, it is lost sight of in a later plan, although the problem is far from solved. The Third Plan treats the marketing problems summarily and the Fifth Plan not at all. The Sixth Plan shifts the earlier emphasis on co-operative to market regulation, but does not take up grading and market intelligence.

The lack of marketing facilities surfaced out in Punjab in the current season. Untimely rains led to a higher moisture content in paddy. Hence, the Food Corporation of India refused to buy the stock causing hardship to the farmers. The angry farmers symbolically

burnt their paddy in Moga and Talwandi and also resorted to road blocks. All this could have been avoided if proper drying and storage facilities had been made available in the market. These are pointers to the problems to be faced in the twentyfirst century.

It is clear that there is a gap between the policy objectives as set out in the Five Year Plans and the legislative provisions in the related field. It is not as if all instances where the gap prevails have been discussed in the paper. The purpose of the paper is to be indicative and not necessarily exhaustive; a closer look at details would certainly reveal more gaps. What is sought to be highlighted is that it is high time a hard look is taken at the whole situation. This is all the more warranted because the Sixth Plan seems to have become complacent in the matter as could be seen from its statement;

> Though the legal framework has been provided through Agricultural Produce Markets Act in most States, the progress in the development of markets and in the enforcement of the Act, has, however, been very uneven. (Pg . 112).

The implementation is not satisfactory but neither is the law itself. As discussed earlier, agricultural marketing will acquire increased importance in the overall agricultural policies in the 21st century.

In the twenty first century the system would not only be required to handle the marketing problems conventionally discussed in 1928.

There will be a host of new problems like diffusion of trade. This has already taken place in Karnataka and the trend is likely to be intensified as the communication facilities improve. Hence, the law needs to be strengthened and continuously updated. In addition formulation of policy should be consistent from one plan to another.

DEMAND AND SUPPLY PROJECTION FOR FOOD GRAINS

N. S. P. REBELLO and LALITH ACHOTH

Summary

An attempt is made to highlight the various ways by which the demand and supply of food grain can be estimated and projected into the future. Projections however can fail because the future cannot be predicted with certainty. To make specific recommendations, the demand has to be obtained and then the gap between demand and supply identified.

One of the main objectives of plainning in India has been to provide people the basic necessities of life, of which the most important is food. Projections of demand and supply are essential for any effort to plan for the future. These provide guidelines for policy decisions, and help in recasting existing policy, wherever necessary.

The dramatic turn about in agricultural output in the country, around the early seventies, was set in motion by the green revolution. Its impact was felt on the productivity of most crops. This generated new interest in the long-term prospects of food production.

An attempt is made here to present the concepts underlying the forms of the functions used in demand and supply projections. Further the supply of some of the important foodgrains grown in Karnataka is projected to 2001 A. D.

Demand models

Consumer behaviour is established with respect to the quantity demanded in response to fluctuations in

income, expenditure and price. Demand growth can be analysed in terms of the population growth per-capita income growth and the effects of income growth, such as income elasticity.

This could be accomplished through using an aggregate level demand model, with per capita demand as the dependent variable. for example :

$$D = b_o + b_1x_1 + b_2x_2 + e$$

Where D = per capita demand for food grains

x_1 = price of the foodgrain/commodity

x_2 = per capita income

e = is the error term.

In estimating demand elasticity for food, an appropriate form for the statistical model should be chosen. The basis for specifying demand functions is the neo-classical theory of consumer behaviour, that consumers maximize their utility, subject to a linear budgetary constraint. There are a number of criteria in selecting a form of the function. From an economic point of view, the function should be able to capture the effect of price. For food, Engel's law should hold and estimated own-price elasticities should be less than one. In addition to the conventional form, expressed in (i), where the main drawback is that the elasticities are assumed to be constant, there are the class of locally. flexible form functions.

i) Indirect Translog model (T.L.)
ii) Generalised Leontief (G.L.)
iii) Almost ideal demand system (AIDS)
iv) Fourier series models.

However, if the data with respect to the determinants of demand preclude the use of the above models, one could take recourse to the familiar function.

$Q = f(t)$

where Q is quantity demanded

f (t) is a function of time.

Supply models

Projection of supply, proxy—the production of food grains, is a more complex problem than that of demand, because the determinants of supply like the prices of inputs and products are not known with certainty.

A commonly used model to estimate supply elasticity, which considers both technological and price adjustments, is the adaptive expectations lag model propounded.

Supply could also be projected by means of a trend equation, but suitable modification will have to be made, with respect to the historical growth rates, while making the projections.

Results

The production of some of the important crops grown in Karnataka has been projected, using trend equations. The study covered the period 1955-56 through 1980-81. the three forms tried were :

1) $Y = a + bt$
2) $Y = at^b$
3) $Y = ab^t$

Based on the most suitable function in explaining the growth, the projections were made to the year 2001 AD, and presented in Table below.

Projections of Karnataka's food production to 2001 A.D.

CROP	Area (000 ha)		Yield (Kg/ha)		Production (000 tonnes)		
	Present	Projection	Present	Projection	Present	Projection I	Projection II
Rice	1102	1199	2025	2815	2232	3184	3375
Ragi	1122	1500	1230	1450	1380	1650	2175
Jowar	1967	1410	835	1689	1643	1836	2380
Bajra	629	766	392	742	247	552	568
Maize	151	151	2603	6906	393	20988	1043
Wheat	364	434	599	710	218	727	308
Total cereals	5802	5459	1111	1603	6447	9198	8750
Total pulses	1530	1725	387	438	592	622	755
Total food grains	7318	7318	944	1672	6912	12483	12237
Total oil seeds	1300	1380	597	600	776	815	827
Cotton	1065	1065	116	152	687	1007	900

It was observed that the growth rates were predominantly either linear or exponential. In Karnataka the area under ragi has shown, the greatest tendency to raise, increasing at the compound annual rate of growth of 3.9. per cent However, the area under cereals have by and large shown a tendency to decline with regard to productivity, most crops have shown a raising trend, registered the most spectacular increase, of a compound growth rate of 7.2 per cent per annum. While projecting area, caution has to be exercised, as area increase is not likely to continue endlessly.

The production of all crops had risen, wheat had registered a growth rate of 6 per cent, with maize growth at a staggering rate of 25 per cent. Food production as a whole had grown by 43 per cent per annum. At this rate of growth foodgrain production of the State should double to 125 lakh tonnes by the year 2001, from the present level of about 69.12 lakh tonnes during 1981.

GROWTH OF INPUTS IN KARNATAKA'S AGRICULTURE - POSITION BY 2001 A.D.

K. S. ARUN KUMAR, R. RAMANNA and LALITH ACHOTH

Karnataka is one of the few states in the country which have made a marked progress in the sphere of agriculture. It has been observed that the agricultural progress in Karnataka is one that needs not only to be commended, but also to be emulated by other states.

Karnataka is one of the leading states of South India both in terms of agricultural and industrial production. There has been an alround development in the State during the past two decades. Per capita income at constant prices (56-57) has increased from Rs. 238 in 1960-61 to Rs. 339 in 1975-76 (and on to Rs. 796.35 in 1983-84). During the period, average annual growth rate of total income at constant prices has been 4.9 per cent as against 3.5 per cent at the National level (at 60-61 prices). Since the beginning of the fourth five year plan, the real growth rate has been 5 per cent per annum on an average.

In Karnataka, over the last 15 years, agricultural base has been strengthened. Considerable investment has been made in the crucial sectors like irrigation and power which forms the backbone for agricultural development. In the field of agriculture a break-through has been achieved through the introduction of the high yielding, hybrid and improved varieties. The state has passed through the initial stages of experimentation with the Green Revolution. The major thrust of the present paper is two-fold :

(a) To analyse the service flow of resources (inputs) over the period 1960's to AD 2001, and (b) Indicate the estimated requirement of major service in puts viz., fertilizer, pesticides, agricultural credit, investment on irrigation, with the estimated (trend) growth in the per cent area under irrigation and the area under high yielding varieties.

It is beyond doubt that adequate supply of inputs at the appropriate time is an important prerequisite for realising production targets.

Fertilizer : Consumption in the state has gone up from a low 2.95 kg/ha of gross cropped area in 1960-61 to 19 kg/ha in 1976-77 (and thus almost on par with that at the national level of 20.1 kg/ha, and on to 36 kg/ha in 1983-84. By AD 2001 the fertilizer consumption in the State is expected to reach (based on the present trend) 97 kg/ha.

The estimated function : $Y = -6.1522 + 2.2982\,x$
$(r = 0.977)$

Pesticides : Use has registered a phenomenal growth with the large scale adoption of high yielding and improved varieties of crop plants. Pesticides consumption went up from 2107 metric tonnes in 1970-71 to 3600 matric tonnes in 1983-84 (4112 tonnes in 84-85) thus registering 70 per cent increase over a period of 14 years, covering an area of 45.8 lakh hectares.

Estimated function : $Y = 1923.37 + 90.7978\,x\ (r = 0.675)$

Fertilizer consumption is expected to in reach an all high 4920 metric tonnes by the turn of the century from a low 2107 metric tonnes in 1970-71.

Agricultural credit : Over a period of 14 years (1969 July to 1983 Dec.) commercial bank credit into agriculture tripled from about Rs. 600 million in June 1969 (before nationalisation) to Rs. 3349 in Dec. 1983 and by the turn of

the century the total credit flow into Karnataka's agricultural sector would amount to Rs. 8577.5 million.

The estimated function : $Y = 1369.0637 + 2557.76\ x$
$(r = 0.958)$

Investment on irrigation : Development of irrigation has received high priority in the Karnataka's development plans. Total investment that has gone into irrigation works out to Rs. 1487 crores by the end of 84-85, of this, the expenditure incurred during the sixth plan is Rs. 7.06 crores. Karnataka state has an ultimate irrigation potential of 54.55 lakh hectares (24.42 lakh hectares under minor and 30.13 lakh hectares under medium and major). By the terminal year of the fifth plan about 36 per cent (19.8 lakh hectares) of the potential was exploited and during the fifth and sixth plan irrigation received top priority over other sectors. During the sixth plan period (80-85) an investment amounting to Rs. 615.66 on major and minor irrigation and Rs. 91.85 crores on minor irrigation was incurred creating a potential of 2.16 lakh hectares under major and medium irrigation and 0.86 lakh hectares under minor irrigation.

By AD 2001, the investment on irrigation is expected to touch an all time high of 1900 crores. An exponential growth is anticipated in view of the steep rise in the construction cost, and in addition the cost over runs due to the non-completion of projects, on time.

The estimated function : $Y = \text{Exp.}\ (3.2754 + 0.1326\ x)$
$(r = 0.974)$

Area under irrigation : It has been increasing at the rate of 0.5 per cent per annum. At this rate of increase, by the turn of the century the coverage under irrigation would be of the order of 35 per cent, as against the current level of 28.37.

The area under irrigation is expected to grow at :

$Y = 11.6953 + 0.502\ t \quad (r = 0.954)$

High yielding varieties : There has been considerable expansion in the area under high yielding varieties from 2.6 lakh hectares in 1968-69 to 15.3 lakh hectares in 1975-76 and on to 27.19 lakh hectares in 1982-83. There has been also a significant rise in the share of HYV in the total area under various crops. The share under HYV was less than 10 per cent for 1968-69 in case of food crops, except maize. This increased to around 20 per cent or more by 1975-76 and on to over 60 per cent in 1980-81. Hybrid cotton has made slow progress. Progress is also impressive in case of area under improved varieties (viz. 100 per cent in case of groundnut, sunflower, castor, sugarcane, 86 per cent in case of cotton and 60 per cent in case of pulses).

Technological break through thus has been reflected in mechanisation of agriculture, increasing use of pumpsets and hence energy consumption, increasing application of chemical fertilizers, pesticides, increased share of irrigated area in the total cropped area.

The estimated function : $Y = -2.7677 + 2.376\ t$
$[r = 0.957]$

Area under HYV has been growing at a rate greater than the rate of growth of area under irrigation. At the historical trend growth rate of 2.3 per cent additional area is added under HYV each year. At this growth rate about 83 per cent of the total cropped area will be under HYV by the turn of the century [AD 2001].

Points for policy consideration

Analysis of the growth of inputs throws light on the following lines which needs to be given priority in policy formulation.

a] By AD 2001 at the present growth rate in irrigation, only 35 per cent of the area could be brought under irrigation in Karnataka. That leaves another major

portion [65 per cent] of the area to be taken up under dry farming conditions. Thus major emphasis has to be given not only to exploit irrigation potential but also to develop better, adoptable technology to conserve more effectively the rain water, and to evolve suitable technology, for dry land agriculture.

b] More extension effort has to be initiated to bring in larger area under high yielding crops so as to achieve higher productivity / acre and in turn overall higher production.

c] More thrust and coordinated efforts from pesticides supplying units, fertilizer distribution depots, commercial banks, is called for.

d] Priority of the Government's sectoral allocation to be given to irrigation investment [has to increase many fold].

AGRICULTURAL MARKETING — LOOKING AHEAD FOR THE 21st CENTURY

P. G. CHENGAPPA and A. N. KRISHNAMURTHY

Agricultural marketing systems are dynamic and operate in unison with the pace of economic development. At any stage of economic development, the marketing system is expected to operate and interact with the production process in such a way as to ensure efficiency in terms of gains to producers without disadvantage to consumers. Therefore, there is need to watch continuously and undertake research on the working of the system and find remedies is essential. In this direction, countrywide studies on subjects like location and economics of storage, transportation, packing, processing and other facilities are necessary. The analysis of price series, price spread, consumption pattern and consumer preference are some other areas of study. It is necessary that suitable methodologies have to be evolved for research studies to make meaningful and practical suggestions.

Thus, if the gains achieved in increasing agricultural production in 21st century are to be fully exploited for maximum benefits of both producer and consumer, it is essential that action programmes be formulated in the following areas:

1. The development of rural markets into full pledged assembly markets whenever it is feasible and others into sub-markets linked to the nearby regulated markets. The National Commission of Agriculture has recommended that it would be ideal if market facilities could be created within a radius of 5 km negotiable by walk or cart within an hour.
2. On an average there is one regulated market per taluk, which is a viable market area as per the NCA,

but the functioning of these markets leaves much to be desired. The following measures are recommended to improve the working of markets ;

a] It is necessary to notify for regulation not only foodgrains but also commercial crops, fruits and vegetables, livestock and livestock products, and minor forest products as a general rule.

b] To ensure orderly marketing each market should have adequate facilities for grading, weighing, storage and for performing other marketing functions as the need warrants.

c] All the transactions of purchase and sale of notified agricultural commodities may be conducted in the specified market yard for a given area and not outside the yard in a scattered manner.

d] Amending the existing Agricultural Produce Marketing Act suitably to ensure that payments are made to primary producers properly through the market committees.

e] The act may ensure that the support price programme are implemented by the market committee by making purchase of the produce from the farmers so as to avoid distress sales.

f] The act may provide for giving credit by the committee with tie up arrangements to repay the same at the time of marketing.

g] Shops selling production inputs and domestic necessities should be made available to the producer in the localities where markets are situated.

h] To carry out the functions of market, posting of qualified officials at regulated markets is essential.

i] Only open auction system and/or tender system of auction should be followed in all the regulated markets. The auctions should be conducted only in the auction platform or pit located in the market yard.

3. The cooperative way of marketing of agricultural commodities is the alternative for the future since it has an involvement of the farmers. In this regard, the sole endeavour of the government should be to a) develop the PCMS and their apex organizations to be the most effective tools in building up an efficient marketing below the town level and b) strengthen the functional bond between the State apex body and other organizations such as Food Corporation of India, State Ware Housing Corporation, Department of Food and Civil Supplies and Cotton Corporation of India In 1945, the Co-operative Planning Committee recommended that there should be one PCMS for every 200 villages and that they should handle at least 10 per cent of marketable surplus within 10 years. This is yet to be achieved since the PCMS hardly handle one per cent of the total marketable surplus.

4. Wherever there are no full pledged PCMS the Farmers' Service Co-operatives should act as marketing societies with contract arrangements with nearby PCMS.

5. To break the monopoly of private sector, a chain of efficiently operated processing units should be established in the co-operative sector. To ensure regular supply of raw materials, the processing units should be linked with PCMS.

6. Grading of all agricultural commodities raw as well as processed intended both for intra-state and inter-state may be made compulsory. The grading should

be based on a simple procedure laying down one or two recognised quality factors. All products meant for inter-state should be graded as per AGMARK and certified by the DMI.

7. Improved storage structures needed by farmers should be manufactured by agro-industries corporations and entreprenuers as per Indian Standard Institution specification.

8. The storage capacity of Food Corporation of India, Central Warehousing Corporation, State Warehousing Corporation and Co-operative should be increased and linked with grain bank so that the receipts issued by them can be made use by the farmers to get advance money.

9. All State Governments should create a "Market Development Fund" to which market committees should contribute certain percentage of market revenue and State Government should contribute matching grants so that research, education and extension on marketing can be undertaken. This fund may be made use of for developing financially weak markets also.

10. Enacting legislation empowering the DMI to inspect the market functions and marketing institutions engaged in inter-state commerce especially in cotton, oilseeds, tobacco and other commercial crops.

11. There is a need to create a uniform structure for agricultural marketing administration in all the States. As suggested by the NCA there should be a full fledged Directorate of Agricultural Marketing in every state.

12. Agricultural Marketing Boards should be set up in all States with both advisory and policy functions.

13. The Ministry of Agriculture and Irrigation which has to discharge the responsibility for formulating agricultural marketing policies should be enabled to have more decisive voice in the formulation of policies of commodities like jute, cotton, tobacco and coffee which are under the purview of respective corporations or boards under the Ministry of Commerce. The Ministry of Agriculture and Irrigation should be given more positive role in formulation of policies affecting the cultivators of these crops solely due to the fact that the requirements of the nation should be looked as whole rather than as separate entities.

DEMAND AND SUPPLY PROJECTIONS OF TEA, COFFEE AND RUBBER IN INDIA TO 2001 A.D.

B. V. CHINNAPPA REDDY, LALITH ACHOTH, T. N. PRAKASH and J. V. VENKATARAM

The plantation economy of India constitutes the bul-walk of India's export earnings among the traditional items of exports. They contribute sizeably to the national exchequer by way of Central and State taxes. They provide employment and to some extent preserve ecological balance in the region. India holds a prime place with respect to tea in the World. Though the production of coffee in India constitutes a meagre 2 per cent of the World coffee production, Indian coffee is of high quality and earns valuable foreign exchange. Rubber in India has a wide range of industrial applications and demand for it is growing ever rapidly in view of preferential treatment given to industrial development in the country. This paper attempts to study the present growth and future prospects of these three important commodities.

The data was analysed for the period 1965-66 to 1981-82 for the three commodities under the study. The growth rates were estimated using the conventional growth function $y = ab^t$, where b-1 is the growth rate. Projections were made with these growth rates as the basis with suitable alterations wherever necessary.

Tea : The supply position of the tea during 2001 A.D. appears to be poised to meet domestic consumption fully which is projected to grow at a rate of 4.76 per cent per annum to 8,40,000 tonnes. If yield increase maintains the present rate of growth of 2.2 per cent and area increase slow down to 0.5 per cent per annum up to the year 1996 beyond which any new area brought under tea, will not contribute significantly to production in view of gestation period of 5 years, puts the

bearing area during 2001 A.D. at 4,23,400 ha. If this is the situation, the production will be 9,30,000 tonnes by the turn of the century. The domestic demand by that time will absorb all but 90,000 tonnes which will be the surplus available for exports which would mean on almost halving of the present exports. However, if we have to preserve exports at the present level without destabilizing the domestic market the level of production required would be of the order of 10,40,000 tonnes, assuming that area will not be changed from the projected figure. Then the productivity will have to increase to at least 2456 kg/ha. which will call for a stepping up the growth rate of productivity from 2.2 to 3.3 per cent. This could be accomplished by undertaking the replacement and rejuvination of the existing area which have become old and consequently less productive.

Coffee : The production of coffee in India witnessed rather a moderate growth rate of 1.85 per cent per annum. However, the domestic consumption of coffee has not matched the production growth rate and it was very low at 0.8 per cent annum. The rest of the coffee produced is being exported to other countries under the International Coffee Agreement to member countries and to non-member countries as well. The exports during the same period registered a significant rise of 7 per cent per annum raising the exports from 26,505 tonnes in 1965-66 to 83,817 tonnes in 1981-82.

The projection of production for 2001 A. D. is made considering both domestic consumption and export requirement for 2001 A.D. If exports grow at 3.0 per cent per annum the quantity to meet our exports commitment should be about 1,47,000 tonnes by 2001 A. D. Thus, the total production requirement will be of the order of 2,10,000 tonnes by the turn of the century which would warrant a growth rate of production of only 1.7 per cent per annum henceforth.

This increase could be achieved only by enhancing the productivity. The policy of the government should be not to

encourage area expansion in non-traditional areas of coffee. This increase could be achieved by accomplishing a yield growth of 2.2 per cent per annum which would raise yield to 1050 kg/ha without adding any new area under coffee.

Coffee in India is characteristic of a surplus economy. If this present rate of growth were to continue, we would be saddled with a large surplus. Therefore certain corrective steps should be intiated and the increase in production should be obtained by increasing the productivity rather than increasing the area under the crop. Thus, certain alternatives should be explored for the utilization of area like planting rubber or other plantation crops.

Rubber : Rubber is one of the plantation crops having wide range of industrial applications. About 70 per cent of rubber in India is being utilized by transportation sector alone. Though India is not a leading rubber manufacturing country in the World, it is still manufacturing a considerable quantities of rubber. An examination of production of both natural and synthetic rubber over the past years indicated that the production of rubber in India was growing at an annual rate of 5.6 per cent. Natural rubber accounted for about 86.88 per cent of the total during the year 1981-82 and the rest was synthetic rubber. However, the consumption of rubber in the country increased at a compound growth rate of 6.13 per cent per annum. Assuming that the rate of increase in natural rubber production may not be sustained at the present level of 6.93 per cent per annum it may reduce to 5 per cent per annum, it would result in a production of 3,86,200 tonnes. Area projections at 2 per cent as against 3.3 per cent in the past would result in 2,85,800 ha under rubber production. Yield which had grown at 3.04 per cent and is projected to grow at 3 per cent per annum. The product of projcted area and yield results in a production of 39,100 tonnes which is very close to the projected production of 38,600 tonnes obtained by projecting the production at 5 per cent.

It is not out of place to mention here about the recent industrial policy of the Government of India regarding the import of technical knowhow from developed countries liberally. This has resulted in the tremendous growth in automobile industry leading to increased demand for rubber by many folds.

In light of the development in automobile industry the consumption of rubber in India is projected to grow at 7 per cent per annum. Thus, the requirement of rubber will be around 6,36,300 tonnes by 2001 A. D. However the natural rubber production projected at 3,86,000 tonnes would still leave a gap of 2,50,000 tonnes by the turn of century. If this gap were to be bridged by the synthetic rubber the asking rate of growth of synthetic rubber production would be 13.36 per cent per annum. This need not be an insur mountable task since it is an industrial product and with the proper encouragement the necessary investment in this sector would be forthcoming.

Conclusion : From the foregoing analysis the following points merit consideration :

1. The present rate of consumption of tea vis-a-vis that of production would bring about an havling of exports to 90,000 tonnes. Thus production should be increased to at least 10,40,000 tonnes so as to preserve our exports.

2. Coffee economy is in a state of surplus and present rate of growth will result in large surplus. Large scale expansion of area should not be undertaken especially in non-traditional areas and thrust should be towards increasing productivity to meet requirement of the future.

3. Rubber would continue to be in short supply even in 2001 A.D. The chronic shortage of rubber availability in the country could be mitigated by increasing synthetic rubber production by devising ways and means of making them cost effective.

AGRICULTURAL CREDIT POLICY — RETROSPECT AND PROSPECT

T. R. KESHAVA REDDY

If there is anyone, who fully understands the scriptural injunction -By the sweat of your brow, you will eat your bread - it is the farmers and agricultural labourers in rural areas. The grim paradox of hungry (rural) people who till the land and feed the well nourished.

For improving the quality of these rural people, the agricultural credit is one of the component of the minimum package consisting of (a) agricultural extension, (b) supply of inputs and (c) Marketing. Credit is a double edged weapon, so it should be used more scientifically and judiciously.

Sources of agricultural credit

The two broad sources of agricultural credit are Institutional and non-institutional sources. Each one having different aim and approach to agricultural credit problems.

The non-institutional credit sources are still an important source of agricultural credit even though its proportion in total rural credit is decreasing over the years.

Characteristics of Indian agriculture

Indian agriculture has predominantly marginal and small dry land holdings. The productivity of land depends not only on the decision of farmers but also on the decisions of government and techical experts by making available the suitable technology, services and agricultural credit policies.

Indian agriculture suffers not only because of shortage of capital but also management. Compared to the Agricultural

contribution to GNP the investment in this sector is insignificant. Accordingly the agricultural productivity and profits are low.

It can also be seen in Indian agriculture, a strong correlation between irrigation and HYV programme. If there are any improved technologies in dry land it has still to make a substantial impact in Indian agriculture and economy.

Role of agricultural credit

Credit is only one instrument for promoting agricultural (rural) development. The demand for credit depends on the agricultural (economics) development and structure of the agricultural economy. Credit itself cannot substitute for structural reforms. This does not mean that there is no role for credit in social reform. Credit is essential as a complement to structural changes. Lending to numerous small, marginal and agricultural labourers is much more complicated than to few large farmers or Industrialists.

Some agricultural credit principles and policies to make small farmers credit programmes a success

Non-institutional agencies like money lender continue to be an important agency in rural credit scene, unless institutional agencies design appropriate schemes which provide easily accessible adequate, and timely agricultural credit to farmers.

Because of "Principle of increasing risk" of borrower capital, the farmers with low equity capital must be delinked from security. Of course the "risk" to the lender has increased but it can be certainly lessened or perhaps largely eliminated during normal agricultural years if the lender follows the concept of supervised credit in its true sense, "Credit will have only good production impact and recovery becomes easy and depends to large extent on the technology package he has provided".

The importance of the "human factor" in strengthening the agricultural credit structure and schemes should be fully appreciated by everyone. Often the farmers feel agricultural credit staff are too 'isolated' from their problems. Hence, vigorous efforts should be made to train official and non-official co-operators and agricultural staff.

During the initial stages of agricultural development, due consideration should be given to the necessary consumption needs of low-income farmers otherwise the agricultural policies and schemes may fail to bring about desired agricultural development and higher incomes in rural areas. One cannot deny the need to meet the necessary consumption needs of farmers, which is being done to workers in the orgnised public and private enterprises.

The supply of short-term credit would have little impact on the growth of agriculture unless it is supported by term finance. Thus it calls for implementation of "single window disbursement" of all agricultural loans. This will certainly avoid unnecessary and often costly approaches by the farmers to different institutions, situated at district places.

The Co-operatives in rural India can be made as a tool of socio-economic development, only if political party in power stops interfering unnecessary with agricultural co-operatives, but should continue to guide, supervise and finance these co-operatives to make them self-reliant, democractic and strong viable institutions. The deficiencies we right now find in agricultural credit co-operatives are not inheritant in the system but due to human and organizational weakness. These deficiencies can be overcome easily only when all political parties agree not to use the Co-operatives as a means to achive their selfish ulterior motives.

The agricultural technologists employed must have proven ability to go beyond the academic forntiers to practical action in the field. The educated people must learn to live in two

worlds - the world of books and the world of life. They must be trained to develop the sense of equity and social justice. He must not only 'see' but 'feel'. Wise people say that "no amount of knowledge in the head can make up for the lack of feeling in the heart". This inability or failure of human resources should be tackled properly to make credit programmes a success. The success and effectiveness of any programme can be measured only by the extent to which it was able to achieve its goals or objectives.

The credit programmes will be success in India, when the constraints in agricultural growth that are found in our economy are also removed. The Indian farmers have shown practically that they are willing to work hard and adopt to profitable innovations. The environment in which the farmers operate needs a change, the technology available to them, the incentives for production and investment, the availability and price of materials such as fertilizers, improved seeds etc. and the provision of irrigation and the market imperfection in agricultural products. It is worth creating a necessary climate to take up agricultural production as a business enterprise only then any programme in agriculture will be a success.

The most visible agro-technological improvement are in irrigated and assured rainfall areas and to a very limited extent in dryland areas. Hence, productivity, employment and income generation per unit of input varies widely between two areas. Therefore, it calls for an altogether different strategy to be followed in agricultural credit programmes between these two areas.

The leaders and officials of agricultural credit institutions must be fully made aware that loans will have adequate impact and would be fully recovered only (a) when farmers are not seriously indebted, (b) all his legitimate needs are properly filled and (c) the return from production leaves him enough capital to meet his consumption needs after loan repayment.

Most of the programmes in India like bank nationalisation, IRDP, special component programmes, DRI schemes and so forth are laudable programmes if we analyse them carefully and view the spirit behind each programme. Most of the objectives, policies and principles of good agricultural credit programmes are embeded in each one of them. These programmes conceived with noble objectives have failed in reaching the minimum expectations. Many committees set up by Reserve Bank of India from time to time, have come out with appropriate techniques and procedures, formulated credit policies and recommendation for strengthening the rural credit. The failure of rural credit programmes is the failure of "human factor" in combining agricultural credit with the right technical guidance and accepted by beneficiaries in the right spirit.

MOBILISATION OF FINANCIAL RESOURCES FOR AGRICULTURAL DEVELOPMENT IN KARNATAKA IN 21st CENTURY

J. V. VENKATARAM and G. NANJUNDA GOWDA

Karnataka State's existing levels of achievement as measured by development indicators rank among one of the average states in the country. In Karnataka, agriculture continues to be a dominant sector. Hence, agriculture requires preferential treatment in investment by institutional agencies since the incremental income from a unit of investment in agriculture is next only to manufacturing.

The extent of irrigated land to the total cultivable land is very low (15.8 per cent). Several studies have indicated good prospects for improving minor irrigation facilities, while the returns from major and medium irrigation projects have been disappointing.

In Karnataka, over 3/4th of the cultivable area is dry land. Therefore emphasis has to be laid either on exploiting irrigation potential and/or dryland development. Impressive strides were made in evolving and propagating hybrid and high yielding varieties of cereal crops which is a great source for augmenting agriculture production. But the area under high yielding varieties has increased only marginally from 24.38 lakh hectares in 1980 to 30.64 hectares in 1983—only 25 per cent increase in three years.

The population of Karnataka is expected to be around 47 million by 2000 AD and to meet the foodgrain requirement, it is estimated that food production should be doubled between 1981 and 2000 AD. Therefore emphasis during 21st Century should be on minor irrigation and land development. An additional 84,000 hectares of land can be brought

under minor irrigation but due to inadequate infrastructural facilities in ground water resources development as well as lack of proper implementation of minor irrigation programmes, the progress is slow. Similarly there is potential for developing 4 lakh hectares of land under land development programme besides developing 1,454 lakh hectares of dry land.

It is very much necessary that about 5 lakh small farmers and 8 lakh large farmers who have opportunities for exploting minor irrigation facilities are to be financed through institutional agencies for sinking irrigation wells (bore wells or open wells). Capital investment for sinking wells would be Rs. 35,000 per farmer involving an outlay of Rs. 1,750 crores for small farmers and Rs. 2,800 crores for large farmers. Besides term loans, provision of crop loans to the tune of Rs. 137 crores for small and Rs. 470 crores for large farmers is essential.

Several research studies on minor irrigation have revealed that benefits realised by small farmers from investment in minor irrigation are larger than what is realised by large farmers thus satisfying the principle of growth with equity. The incremental income realised through this investment is expected to be Rs. 208.26 crores per year (at the rate of Rs. 1602 per farmer per year) from 13 lakh farmers to be financed for sinking wells. Investment for land development in major irrigation project areas by way of medium term loan is estimated to be Rs. 142 crores for developing remaining targeted area of 12.8 lakh hectares (at the rate of Rs. 1102 per hectare). The incremental income to farmers from this investment is estimated to be Rs. 444 per hectare accounting for Rs. 57 crores per year from 12.8 lakh hectares.

In addition to investments in land development and minor irrigation, adequate provision for mechanisation of

agriculture has to be made particularly to large farmers. Karnataka envisages to cover 500 farmers per year under tractorization programme by 21st century as per the seventh five year plan estimates. This would involve financial accommodation of Rs. 3.75 crores which could be raised through floating special debentures by land banks. This is estimated to add Rs. 1 crore (Rs. 20,000 per farmer per year) to Karnataka State product/income.

Besides, allied activities such as dairy, poultry, piggery programmes for marginal farmers and agricultural labourers should be promoted for the development of landless and allround development of rural sector. Rupees 300 crores are required to cover 10 lakh population under these allied activities.

All the aforesaid investment areas should be provided credit accommodation on priority basis and greater commitment on the part of the financial institutions and government in terms of goals, constraints and strategies of financial is necessary. Though the prospectives of institutional financing for agricultural development during 21st century are indicative, an attempt is made to project the requirements based on the past trends.

The development of institutional network of cooperatives, regional rural banks and commercial banks is expected to be 25,000; 1525 and 6500 respectively during the beginning of 21st Century as compared to 1985 position of 23,120 co-operatives, 485 regional rural bank branches and 3730 commercial bank branches in Karnataka.

Assuming that at least 50 per cent of the total advances would go to agriculture on priority basis from commercial banks, the availability of funds is estimated to be Rs. 2800 crores, while the regional rural banks which provide all their advances to agriculture are expected to provide about

Rs. 350 crores and 90 per cent of the Co-operative advances account for Rs. 189 crores in the beginning of 21st century.

The financial resources projected for the agricultural development activities can be mobilised as done in the past through various agencies.

The financial resources for agricultural development from the existing institutions can be expanded further if governments can induce and motivate rural savings. The total financial resources required for various activities to foster agricultural development are as follows :

Term loans	:	Rs. 4,695.75 crores
Short-term loans	:	Rs. 607.00 ,,
Allied activities loans	:	Rs. 300.00 ,,

The dryland development for which the Boards have been established require about Rs. 260 lakhs per year besides Rs. 333 lakhs for soil and water conservation programme which will be a commitment on the part of the State Government. The development of infrastructural facilites for Agricultural Marketing also require as per the State Government estimates about Rs. 15 lakhs by 2000 A.D. Besides, the creation of rural grid (warehousing facilities) requires around Rs. 25 lakhs as per the Seventh Five Year Plan estimates. There is also an urgent need to develop processing activities through Karnataka Agro Industries Corporation and the commitment on the part of the State Government is estimated to be Rs. 120 lakhs per year.

BANKING ON RURAL FRONT

S. R. RANNOREY

In a predominently agrarian country like India, where more than 3/4 of its population lives in villages, any endeavour at National building should automatically be directed towards rural reconstruction to combat pervasive poverty, illiteracy, ignorance and exploitation. In consonance with the policy of the Government for ushering in a new era of economic transformation in the living standards of rural population, banks have involved themselves in a big way by quickly grasping the heart of National policies and priorities.

To give banks a decisive role in the development plans of India in subserving the socio-economic policies, social control over the banks was introduced on major commercial banks in 1968,which was followed by their nationalisation in 1969.

After nationalisation there has been a significant change in the complexion of Indian Banking. Presently they are acting as the instruments of social and economic change, rather than profit earning units. Major change in the approach of banking services from classes to masses with purpose and result oriented rather than security oriented. The agricultural sector has been given the highest prominence, with liberal credit assistance.

To cover larger population, more bank offices were opened in remote and unbanked areas. Between 1969 and 1984 from 8,292 to 38,277 branches were opened with per branch population at 65,000 in 1969 to now at 16,000. Emphasis was laid on expansion of branches in rural areas which resulted in opening of more rural branches which stood at 18,157 as on 1984 from 1800 in 1969.

In helping the poor and overall development of our country, the banks have an important role to play. To ensure credit flows significantly to certain vital sectors, the concept of priority sector was introduced. The Government of India also fixed a target of 40 per cent of total advances to priority sectors, 15 per cent of total advances to direct finance to agriculture and 10 per cent of total advances towards weaker section. These targets were set to be achieved by March 1985 by all commercial banks.

For rural development, several schemes were started, in which the banks are actively involved.

a) Differential Interest Scheme for lending to the poor at low rate of interest (40 per cent)

b) Lead Bank Scheme - To give a momentum to the tempo of economic growth by providing gainful employment to people particularly small borrowers and by reducing regional economic disparities, by invoking the co-operation of other development departments of Government.

c) New 20 Point Programmee and Integrated Rural Development programme - To meet the financial needs of the poorest of the poor.

d) Village Adoption Scheme, National Rural Employment Programme, Rural Landless Employment Guarantee Programme etc.,

By experience, several programmes for rural development suffered from certain inherent defects viz., schemes implemented were of adhoc nature, no scientific surveys were undertaken to identify the real rural poor, not considering the backward and forward linkages, and emphasis on disbursement of money than end results, etc.

Hence the task ahead, to achieve our Prime Ministers vision of New India by 21st century, a lot more has to be done.

a) All Rural Development Programmes have to be based on a comprehensive resource inventory,

b) Creation of rural marketing and more service centres for strengthening, specially the rural industry sector,

c) Need for periodical revision of the scale of finance depending upon factor prices and make provision for adequate consumption loan to prevent the poor beneficiaries from seeking bridge loans' from private sources,

d) To improve the quality of the rural development schemes, instead of indulging in target approach, the objective must be to focus funds and administrative resources on a smaller number of beneficiaries and make sure that they cross poverty line,

e) Need for more and more involvement of voluntary/ rural development organisations along with commercial banks,

f) Rural bank branches be made compulsorily to adopt 2 to 3 villages and responsible for the development of the village,

(g) Adequate representation be given to rural women in rural development programmes,

(h) Strengthening the properly trained extension personnel at various levels to successfully administer the programmes for agricultural developments in co-ordination with other institutions,

The measures listed are only illustrative and not at all exhaustive.

MANAGEMENT SERVICES TO SMALL FARMERS — A NEW STRATEGY ESSENTIAL FOR THE 21ST CENTURY

K. A. JALIHAL and V. VEERABHADRAIAH

Agriculture in India has made great strides since 1960s. The increase in food production from 50 million tonnes in 1950 to 150 million tonnes in 1985 speaks for this phenomenal progress. Nevertheless, inspite of this Green Revolution, the grains from the technology have been mostly gone to the well-to-do farmers, who not only had easy access to technology but also to credit, while the small farmers did not get adequate share of the benefits of green revolution.

Experiences of several development programmes in India have indicated that participation of small farmers in development programmes, except in limited locations where intensive extension programmes were in operation like the Village Adoption Programme, Block Demonstration Programme, 1,000 Hectare Programme and Location Specific Technology Around Rainguage-Stations, has not been encouraging. Even in the above mentioned programmes the participation of small farmers is mostly for the period of programmes are in operation.

Can anything be done to help these disadvantaged small farmers and their families by way of education and related support services. The first step in this direction is to recognise, that experienced and progressive commercial farmers require a great deal of *less help* to move ahead than do small farmers with few resources and little, if any, experience with modern technology, credit and commercial markets. The larger, *more progressive farmers* can learn and do it by themselves; what the government can most usefully do for them is to create attractive opportunities, mainly by breaking political bottlenecks. *The small farmers need more help* just to get moving and

especially to cross that great *divide* between the subsistence sector they are now locked into and the modernsing commercial sector. They are also far more numerous. As Hunter (1970) has suggested, some one must intercede from outside on their behalf, if they are to get off dead-centre. Coombs and Ahmed (1974) observed that "to assume that an infusion of education alone will propel these small subsistence farmers forward would be naive. Education infusions are vitally important, but they must be seen as elements of a broader and more complex solution and must be planned in this wider context". After a careful review of several development projects in different developing countries, these authors have advanced a *theory of providing management services to small farmers* as a new strategy to accelerate the development of these weaker sections. A brief outline of this theory can be better understood in the words of these authorities which are as follows :

> "A cause as well as a symptom of rural under-development is that the facilities for provision of services and supplies are absent, inadequate or do not function effectively. But when the provisions are made, they cannot be made to function adequately and effectively without a mechanism for management, co-ordination and adaptation at the local level..."

It is in this matter of management where the larger farmers have a crucial advantage. The extreme example would be agricultural estates and industrial and agricultural units, which are essentially tight-knit management systems from top to bottom. But any large and efficient farm is managed on the same basic principles - as a production "system". Small farmers, especially subsistence farms, are not treated by their occupants as production units; they are seen as way of life.

Government in varying degrees have been providing the four kinds of needed help - engineering, technical, economic and social services, but rarely have they even tried to

provide the fifth; management services. In the absence of any integrated, a systematic view of the farmers' overall situation, each rural support service has been viewed as an independent factor and each organisation has gone its own way. The need for management services to tie them together has rarely even been recognised.

Guy Hunter suggests, and we agree, that what is needed is not prescriptive approach but an enabling approach whereby various management services, located within easy reach of farmers (perhaps at a multipurpose rural development centre in a nearby market town) would respond to their specific requests for help. Such a management service would not prescribe or in any sense act as a regulatory agency or an enforcer of government dictates and targets. Rather, it would offer encouragement and aid to small farmers. It could for example, help them get credit or input deliveries on schedule or help them organise the marketing of their produce. It would also, when the time is ripe, help them organise their own association to deal with some of these needs. If tied to realistic development plan for the area, the management services could also help them interpret its implications for their own situation.

As an empirical support for advancing the management services theory Coombs and Ahmed (1974) further say "It is worth noting that the distinguishing feature common to various integrated development projects is that they attempt to fill this management vacuum at the local level. Each of them has established a management structure for the local development programme whether its focus is on agriculture or broader rural development."

New functions by agencies : In the Chilale Agricultural Development Unit (CADU)of Ethiopia reported by Nekby (1970) the extension agents and their assistants were multiple function field workers. They not only taught and assisted farmers in applying new methods and practices, but also assisted in

the credit programme, participated in contract discussions between farmers and landlords and acted as general representatives for the project within their respective areas.

In the Block Demonstration Programme of Karnataka as reported by Anon. (1973), the co-ordination of agencies assisted in providing the manage ment services in the following ways.

1. Farmers meetings were organised by extension workers in villages two months before the season to discuss about the advantage of using new farm practices by farmers. As a result of these meetings several farmers were motivated.

2. Listed out various requirements of these farmers in respect of seeds, fertilizers, chemicals, credit, etc.

3. Extension workers belonging to various organisations such as Department of Agriculture, University of Agricultural Sciences, Farmers Service Societies and Commercial Banks shared these responsibilities and assisted participant farmers in getting their requirements.

Empirical data relating to management services

A Ph.D. study on evaluation of Block Demonstration Programme by Sawant (1978) revealed that in these Block Demonstrations where management services were provided through effective co-ordination, the involvement of small farmers was high and also more number of participant farmers could get assistance from agencies.

How to provide management services ?

There is no one method to provide management services for farmers. Hunter and Bettral (1974) have suggested that on an experimental basis 'Farmers Service Centres' should be established about five in a block to which farmers could come for

extension advice, supplies, credit, market information etc. According to Coombs and Ahmed (1974) the long range solution to the problem of making rural education and development programmes, a service to the needs of the disadvantaged majority rather than a relatively previleged few, will lie in a deliberate policy of organising political voice of the poor, encouraging them to take their rightful place in local power structure, and ensuring their participation and involvement in the decision which affect their welfare. Local institutions such as farmers associations, co-operatives, irrigation groups and village councils can become the means for the small farmers to organise themselves for placing their own needs and priorities and for progressively taking the management of their affairs.

Karnataka State is new in the process of ushering a new era through Panchayat Raj system. A specific statutory responsibility to the Mandal Panchayats may be entrusted to provide the much needed management services to small farmers so as to assist them in agricultural development at least in the 21st century.

REFERENCES

Ananymous, 1977, "Block Demonstration - A Hand Book" Bangalore (India); Karnataka State Dept. of Agriculture.

Coombs Philip and Manzoor Ahmed, 1974, *Attacking Rural Poverty.* Baltimore and London. The John Hopkins University Press.

Hunter, G., 1970, *The Administration of Agriculture Development* Bombay. Oxford University Press.

Hunter, G. and Bettral, 1974, *Serving the Small Farmers - Policy changes in Indian Agricultural Development.* Groom Hilm In Association with the Overseas Development Institution, London, U. K.

Nekby Banget, 1970, *CADU : An Ethiopian Experiment in Developing Peasant Farming.* Stockholm, Prisma Publishers.

Sawant, A. G., 1978, Development of a scale for Measuring Inter-Institutional Coordination in Agricultural Programme with Application - *Unpublished Ph.D. thesis.* Univ. of Agril. Sciences, Bangalore.

MANAGEMENT TRAINING FOR BETTER ADMINISTRATIVE PERFORMANCE IN AGRICULTURE

H. S. HANUMANTHAPPA and K. A. JALIHAL

The importance of training, especially for administrators of agricultural development programmes has been highlighted at various national and international forums. In keeping with this requirement it is necessary to establish training programmes to provide for continuing improvements in the technical, organisational and administrative capacities. Training for policy makers and administrators, especially to improve their understanding of the conditions and problems of rural areas and their ability to respond to the needs of the rural poor, is indeed an important part of the answer to issues connected with improving performance.

Standard "Management" training courses alone are not likely to help develop the knowledge, skills and attitudes which field administrators must possess to be effective in their work. It is also important to recognise that job relevant training must necessarily be "In-service". It has to be continuous process to learning from experience and learning to put newly acquired knowledge to actual use in the field in improving performance.

The present practice of the Government Development Departments is to depute and get their field level functionaries trained annually to up date their skills and subject matter competence. This practice has unfortunately, not involved the 'Top Brass' viz., the policy makers and administrators and even the supervisors at different levels, in being exposed to management training. Thus the officers responsible for implementing the development programmes are not being trained and as such they are not able to recognise and guide the field functionaries whenever they (field functionaries) are not able to apply the knowledge and skills they

have acquired through regular training programmes. This lacuna can be overcome by involving all the functionaries from 'top to bottom' so that developmental activities could be implemented speedily and effectively. Therefore, instead of following standard approaches of training, the needs and requirements of training for agricultural development will have to be assessed cerefully keeping in view the level of functionaries involved, the specific programmes and their locations.

There is a tendency widely recognised that senior managers do not see the need for their own participation in training sessions, nor do they readily spare their senior staff to attend. This problem is aggravated by a tendency for middle-level managers to be instructed to attend workshops, seminars etc.

The recent experience of the University in working with the management consultants of the U. K. based Coverdale Organization in conducting management training courses for Senior Administrators, middle-managers and field level functionaries of agricultural development in the State, has emphasized the need for a systematic and periodic exposure of these Government functionaries (from bottom to top) to the principles and practises of management in agriculture.

The training efforts to be planned should be addressed to government functionaries at different levels and for the sake of clarity five different levels can be visualised. These are:

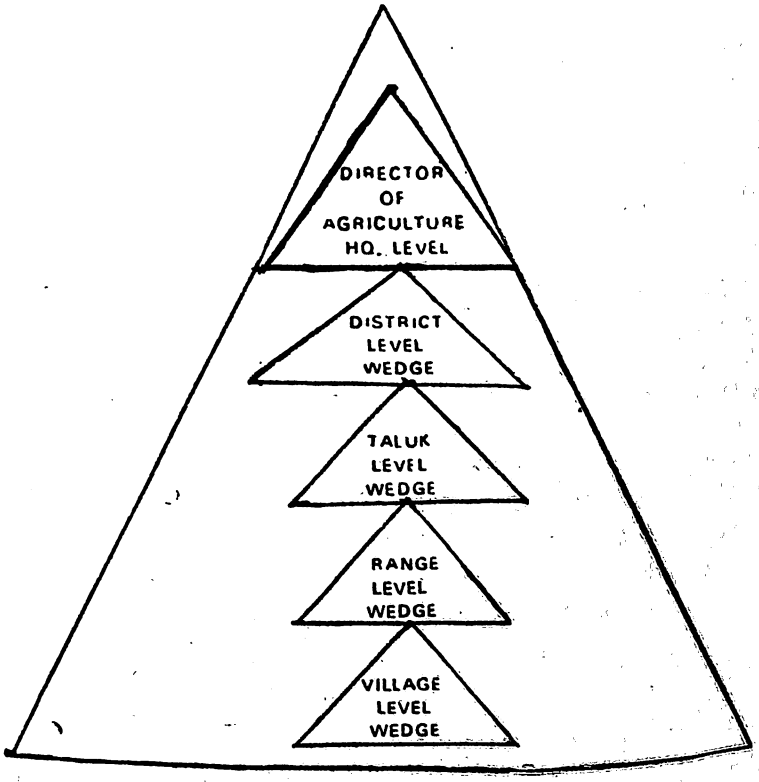
i) Supervisory staff at the field level;
ii) Supervisory and technical staff at the district level;
iii) Regional level officials;
iv) Heads of Departments/Directorates;
v) Policy making staff (including administrators)

Management training programmes for government functionaries of the State of Karnataka

In view of the above considerations the entire hierarchy of the organization should be brought under the fold of training at the same time. In this direction, the Coverdale

Consultants' brief experience of working in the State has revealed that it is counter-productive to work only at the senior levels and that an early indepth activity is necessary as well. This means developing "Wedges" of activity based on the hierarchy. A wedge comprises the people who work together at a similar level within the same department or section, so that in moving down through the hierarchy a a number of wedges (groups) of Managers will be involved. In a relatively short time, the senior managers and steering groups can review benefits and results for each level and take action to improve as shown below :

STATE DEPARTMENT OF AGRICULTURE
(Model)



Agricultural Extension Wedge

By this wedge approach it is possible to bring different categories of trainees under the fold of training with minimum loss of time so that there is better management of time and resources for effective programme implementation. Hence, in all future training programmes of the University it would be desirable to adopt the 'wedge' approach in training the entire hierarchy of functionaries in Development Departments.

PRACTICAL PROBLEMS FACED BY INDIAN AGRICULTURISTS

K. M. MONNAPPA

The present bureaucracy, imbecile planning, unremunerative price for agricultural crops, vested interest and corrupt practices prevailing in co-operative sector, heavy taxation, absurd commercial restriction and corrupt officials, distribution of sub-standard seeds and inputs, lack of mechanisation and basic amenities in villages, has brought about the natural effect, the migration of villagers to town and cities.

As an experienced village agriculturist settled in a village, I want to draw the attention of the Government, the real problem faced by the cultivators and if it is not solved practically by 21st century, all the farming and plantation community in villages may migrate to towns and cities, seeking employment.

The first and foremost enemy of the agriculturist is the official bureaucracy prevailing in Government and Co-operative sectors. Amidst toiling in rain and sun, he has to approach for a small land record, 1) Village Accountant, 2) Revenue Inspector, 3) Tahsildar and 4) the Dy. Commissioner and the paper has to undergo scrutiny by case workers at all these four levels. So, to get a small work done at Government level, it will take months together, which, he has to do, neglecting his agricultural operations. Such are the problems, he has to face from other Government Departments also.

The Ministers always issue statements favourable to farmers from public platforms, without issuing proper Government orders. But the officials will not implement the same on the pretext of rules and regulations. So, if any farmer acts on

the statement issued by the concerned Ministers in public platform or with the Press, the departmental officials with the assistance of Police, would arrest him and give him all sorts of troubles.

Now the planning in agricultural sector is done either at New Delhi or at State Capitals, without the representation of the practical farmers and without considering geographical position, climatic condition and mentality of the villagers of the area. This should be decentralised and planning should be done at village, taluk, district levels and then transmitted to State and Centre. While nominating farmers to agricultural sector planning, real talented, outstanding farmers should be nominated and politicians should not be nominated. As a striking example of imbecile planning, I would cite - Government of India Coffee and Cardamom Boards, where politicians are nominated and their performance is not upto the level expected.

The Government has not taken into consideration, the cost of cultivation of agricultural products, before fixing minimum support price. The Government should work out the cost of production of commodities, at their own experimental farms and fix minimum price on that basis. While the industrialists could fix the price of their articles and sell the same in the market, keeping a margin of profit, why the same facilities are denied to the farmers? If the present underselling in agricultural sector continues for few more years, a day would come when the villagers would rush into cities seeking jobs and cause explosion of population in cities.

At present, concessional loans, distribution of essential commodities are channelised through co-operative societies only. But unfortunately, corruption is so rampant in co-operatives, that non-professional persons have taken the helm of affairs of co-operatives by manupulating voters and corrupting them. The natural effect of this is the sanction of binominal loans, resale

of essential commodities for profit to traders in collusion with officials. Consequently,without bribing the committee members and the staff of the co-operative society, the farmer will not get loan or essential commodities, in time. So, it is suggeested that fresh legislation may be brought that, in future, no President or Director should continue in the same institution for more than 3 years. Misappropriation cases should be settled within a year and the then Board of Management and staff members should be made collectively responsible for non-recovery of loans, misappropriations and selling of essential commodities to traders for profit. Alternatively, I suggest that 40 per cent of Reserve Bank concessional finance, be channelised through scheduled banks and this loan may be given to farmers to whom co-operatives do not sanction loan, and green card system be introdnced at village level for supply of essential commodities to weaker sections.

The Centre and State Governments have levied so many varieties of direct and indirect taxes on agricultural commodities, that it is highly impossible to continue honest livelihood by farmers when the price of agricultural and plantation crops has crashed in internal and world markets. So, it is suggested to abolish professional tax, agricultural income tax and other central taxes levied on Coffee, Cardamom and other agricultural commodities, for the present. The farme machineries like Power Tillers, Trailers and Tractors, should be exemted from taxation and inspection by the Regional Transport Officers. Diesel, electricity, fertilizers, insecticides and fungicides be given on concessional rates for agricultural operations.

When there is plenty of stock of foodgrains, like rice and wheat at Government godowns, entire India be treated as an unit for movement and unrestricted sale of grains at any part of India, so that, corruption could be avoided.

Another factor, which affects the farmers in the growing corruption at the Government official level, and creating of

unwanted departments and jobs. These Departments consume 60 per cent of the budget money on salaries and other contingencies. While the businessman, industrialist, contractors could be conversant with the language of the corrupt officials and feed them with wine and pocket money in 5-Star hotels, the poor farmer, who is innocent to malpractice, is denied of interview of any of these officials at the attender level itself. If the working of a Government official is probed, the major portion of his time is wasted in building up papers of official's increments, allowances, leave and other previleges and little time is allotted to tackle the problems of the public. So, until officials, contractors, Industrialists, merchants, politicians and farmers are made to feel that they are Indians and they are working for the upliftment of India, India cannot compete with developed nations. The Magistrates and Trade Union Leaders, should see eye to eye with the real problems and the man-days lost in strike and delays in courts and liberalise the present day dealing with justice.

The failure of Seed Corporation and other Research Centres to supply good high yielding disease-free seeds is the major cause for low production of yield. The Government Corporations, Commodity Board's working should be watched by concerned Ministers and if any flaw is found in their working, they should change the pattern of its working.

So, it has been found that prefuse expenditure on Government ministerial staff, heavy taxation on farmers, absurd commercial restriction, corrupt officials, unremunerative price for agricultural and plantation crops, and absence of basic amenities in rural areas, are the main causes for migration of villagers to cities.

AGRARIAN STRUCTURE AND STRATEGIES FOR AGRICULTURAL DEVELOPMENT FOR THE 21st CENTURY

J. RAGHOTHAM REDDY

Farming is stumbling ahead without modern technology and tools. Working under low wage conditions, facing unpredictable weather, compelled by nature to work only for part of the year. If a proof of its outdated state is needed, the country plough and a bullock cart with steel tyres on unmachined axle provide illustrations. The natural and man made handicaps have left farming technologically far behind the Indian industry of today.

Industry can move faster. It can buy technology from any part of the globe, force the pace of production by multi-shift system. The only limitation being the market to absorb the product.

Agriculture including livestock contrarily is biological production, time and season bound, limited by the quality of location specific knowledge and exposed to vagaries of weather and accidents of pests and diseases. Large area under small and marginal farmers does not give full employment, provides substandard incomes leading to malnutrition, lack of energy and consequent steadily lowering efficiency. Unit costs under these circumstances are bound to rise making their supply costly and scarce even for the producers. This has led to huge governmental subsidies to the rural poor who are themselves the producers of food grains.

This disparity of income levels between agriculture and rest of the economy has led to the migration of talent from rural to urban areas. As land holding became less profitable and opportunities increase in business, industry and trade

capital followed talent. Even the genes that make for better human material in the next generation has come to urban and non farm sector. If there is to be a balanced development of the country as a organic whole there must be an equitable sharing of talent, enterprise and capital among all the sectors of the economy.

Challenges to the farming in the next century will come from —

1. Bulging population
2. Relatively high income groups outside agriculture wanting better food at what they consider fair prices
3. Farm product based industries needing better raw material again at reasonable prices
4. Better communication and awareness on the part of rural areas generating a desire for better life; "Explosion of Expectations"
5. Degeneration of eco-system, less forest, eroded soils, silted reservoirs, failing ground water levels and salinity in intensive irrigated flat areas.

If these challenges are to be met we may have to begin by better trained work force.

1. The persons entering labour force from 2001 onwards are now 10 years in age in primary and upper primary classes. Since 2/3 population or effectively same number of persons as of now or a few more will still be in farming. These school children must be imparted a bias for farming, given the knowledge and matching skills.

2. Since part time farmers with more rewarding opportunities outside farming cannot meet the challenge, free market in land should be restored subject to a maximum of newly and rationally defined ceiling on landholdings.

3. Rational and workable level of ceiling in farm land would be an area that would provide full employment (in Agriculture terms) to 2 adults.

4. Freedom of contact in leasee by small and marginal farmers to release them from the thraldom and enable them to do a more rewarding work elsewhere. Kerala and coastal districts of Andhra Pradesh provide illustrations of small holders leaving for urban jobs or turning full time farm workers leasing their lands or putting them under tree crops.

5. In order to partly arrest or reverse the flight of capital from rural to urban areas, it will be necessary to make a distinction between leasing agricultural land and leasing fully equipped farm. This will help people in urban areas to invest their savings in building farms by equiping with tools, machinery, cattle etc., and leasing it as a complete unit of production, the operator contributing just his labour and or managerial skills. It is the latter form of leases where freedom of contract should be restored.

This will be acceptable to urban people as hedge against inflation and something productive to leave behind for the children. It may be recalled that in earlier era Punjab's farm prosperity was built by army personnel sending remittances home and getting invested in farming.

6. Unmanageable food grain stocks at one end, malnutrition in several sectors on the other, coupled with scarcity and unconscionable retail prices of elitist consumer products like fruits, vegetables, edible oil, pulses, mutton, even milk on the other calls for crop planning.

High acre yields of rice and wheat should enable some water and land to be diverted to high cost products, while vulnerable sections need cheap cereals, resources must come from opulence wherever it exists in the country. All products

grown under glass house conditions in northern hemisphere can be cheaply grown and made a source of export carning simultaneously yielding some tax revenue.

Illustratively all rice land under lift irrigation may be shifted to other crops, where more yields can come out of unit of water. If this has not come about already it is primarily the failure of the plant breeder and the agronomist to provide a crop equally rewarding under similar conditions of soil, weather and human endeavour.

7. Education for Agriculture to start from post-matric stage

a) One year diploma for specific groups of crops or livestock to operating farmers.

b) 2/3 year diploma for technicians and farmers.

c) Undergraduate degree in 3 streams of Science, Production and Agro-business.

d) Master degree in each one of these streams as also in sub fields of plant protection, land improvement, soil health care farming systems, irrigated farming, developmental administration etc.

e) Doctoral programme for inservice people specifically in areas of teaching and research in which they are already engaged.

All these in sufficient numbers to meet the challenge of the century yet to come.

8. Transfer of technology.

a) One centre of adaptive research at each primary administrative unit above village or roughly for a population of 1 lakh or an assembly constituency or a block roughly 4000 to 6000 for the country.

b) T & V system to be adapted corrected and made universal.

c) Master farmers or Krishi Pundits to be identified and made to play the role of pace setters by taking apprentices to impart better technology.

9. a) Action programmes to comprise of a subsidy on land development, improving water resources, water conveyance, fencing, water lifting and so on. This to be effictively done without leakage and kick backs.

b) Dryland areas to be seats of industry to be consciously promoted so that what nature inflicts by drought be partly undone by industrial emloyment. Hardy population, low wages better discipline of dryland areas must be harnessed for industrial growth.

10. a) Since small and marginal farmers cannot maintain cattle of their own there would be increasing dependence on custom work by tractors. Design and manufacture of appropriate tractors has to be promoted and costs brought down.

b) Design of productive and efficient tools on a mass scale, steel being supplied at excise free cost to manufacturers is an imperative.

A giant factory in the public sector or as a joint venture is called for.

c) Small farmers use more time watching crops against stray cattle. Multiple and relay-cropping is exposed to the same menace because it covers a small area when the rest of the village has no crop. A special legislation is called for to prevent stray cattle menace to crops. Giving milch animals to the landless, ending up in grazing others' fields should cease.

11. Trade has to be organised into a massive chain stores to provide industrial requirements of agriculture at several thousand nodal points. An appropriate arrangement with manufacturers has to be worked out.

12. Credit procedures to be rationalised and kept within limits of requirements and not allowed to run riot. No unpro-

fitable venture can improve by availability of credit. Credit is for profitable ventures not otherwise possible.

13. Concepts may be good, men may be competent, institutions may have the potential but results will not come except within the frame work of an administrative set up upright, fair, efficient and free from bias of all types. Equality before law and assistance according to need must be ensured.

14. Village administration, land records, law and order, stray cattle menace, rowdy elements must be handled oppropriately for peasants to pursue their profession with peace of mind. Agriculture for next century is interlinked with what the country would do with major challenges—

1. Bulging population;
2. Explosion of expectations;
3. Law and order;
4. Inflation;
5. Education and training.

15. All the tax supported agencies, voluntary organisations, leaders of public opinion, religious Gurus, Babas, Priests and thinking men and women every where can persuade the society to divert the money spent by adults on alcohol to milk for children and shelter for the family, the objective of a better life will be here and now.

19. 26 villages I know of, spent 168 lakhs on arrack alone per year apart from toddy. I beseech you to consider what rural area would be if half the amount is spent on milk for children and half on housing the family. It was easy to pooh-pooh prohibition in early days of freedom. Let a study be made of concerned areas now and see where Government's thirst for tax revenue has lead the country. Anti poverty programmes and the like have lost lot of meaning.

INDICATORS OF CHANGE ON THE FARM SECTOR

A. P. KADEKODI

When we are thinking of entering 21st Century with new strategies - and if possible a new structure in the Agricultural Field - it is necessary to consider the present situation in depth and select the indicators which ultimately bring about a change.

1. Agriculture has been treated in isolation, Departmentwise with incentives and subsidies in cash and kind. Again Agriculture has largely consentrated on field crops-food crops in rainfed areas and cash crops in marginally or fully irrigated areas. Unfortunately tree-crops supporting the field crops are totally forgotten and in our State Horticulture is separated from Agricuiture.

2. Agriculture cannot be without animal husbandry. But they are two independents—Having nothing in common even by way of programming. The Green Revolution which brought in new strains of paddy of short stature and short duration, increased the yield at the cost of fodder. The earlier traditional varieties provided both paddy and straw, the new varieties only paddy. The absence of any stress on fodder either as a field crop or a tree crop created a very wide gap in the animal husbandry programme. A White Revolution in the name of "Operation Flood II" is in the offing without mentioning the development of fodder as a necessary input and giving it due priority Agriculture Department has nothing to do with fodder. Animal Husbandry has no programmes for fodder. Forests cover 80 per cent of the land area, in my district, but the department is not interested in building up of fodder resources. On the other hand supply of milch cattle to the poorer and weaker section, organisation of Milk Co-operatives in the

socalled milk-shed areas and rehabilitation of Goulies are in the offing forgetting that fodder is the main input in all these cases.

3. Land Reforms have reached the penultimate stage so far as ownership is concerned. The tenants have become the owners. But the supplies and services supporting systems, to make these new owners, efficient and self-reliant are not existant.

4. The infra structural facilities for an all round agricultural develoment under these conditions relate to education, Credit and Marketing Facilities, Processing Units, Transport Services and Extension agencies. All these have promoted migration of both things and men to the urban areas in the name of market economy-Exchanging marketable surpluses.

(a) General education has always favoured an urban and anti rural orientation. Agricultural education which is considered of lower dignity and of lower priority again prepares the sons of the soil for jobs or for position of a supervisory nature demanding again urban facility. To meet the requirements of the agriculturists there is no short duration courses in Horticulture, Animal Husbandry or Forestery. Even suggestion made earlier are spurned and disregarded. Only the Agricultural Department has its schools and colleges, with limited entries. The instructions imparted in these institutions is many times irrellavent to the local conditions of agriculturists and it is no wonder if they come to feel that the entry and the exist in these institution is only a ritual for a certificate. The Denish-aided and Japanese-aided programmes are also of a similar nature. Hence one of the major items of infrastructure has contributed to the migration from the rural to the urban areas without creating any significant impact in the rural economy, particularly with the new owners in the agricultural field. Can we not devise, an educational pattern

of compact short duration courses in all aspects of agriculture, as defined by the National Commission of Agriculture and give it sufficient weightage and priority?

(b) Credit and Marketing facilities are mostly in the co-op. field and co-operation is supposed to cover the entire rural landscape. Unfortunately with the growth and expansion of the National Banks and Rural Banks, any new thinking in reorganisation or revitalisation of the Co-op.s has come to a stop. New menagement techniques that could help the integrated view of agriculture was a must for Co-op's now, but neither the Department nor the Co-op. movement leaders seem to be interested in this question except in maintaining their position. Rethinking on the role of co-op.s therefore is a must. Marketing again has not been successful in bringing back to the rural area the supposed prosperity except in the case of plantation crops. In the case of food-crops the vagaries of the monsoons and the uncertainty of the market price giving them a profit and the low priority assigned to the food-crops have all contributed to a vicious circle and excepting cotton, arecanut and groundnut, Marketing Societies in food-crops are a total failure. They are just reduced to supplying chemicals and fertilisers or seeds and equipments and general stores.

(c) Processing units are again in the semi-urban and urban areas. In the case of paddy processing, whatever levy system the Government have introduced, the entire burden has in practice been delegated to the cultivator without helping him any way. With the traditional handponding totally disappeared, hulling of any type subject to licence permit and levy, the marginal farmer and the poor farmer is certainly in a sorry plight of once again going back to the manual devise of processing. The processing units have deprived the farmer even the husk and the bran of the paddy brought for milling. The farmer is not able to take back any nutrients either for himself or his cattle or field from this type of processing. Can

we not have any appropriate technology helping the poor farmer to get the maximum from both processing and marketing?

(d) Transport of course is urban-oriented. What will it bring back to the rural area? It may take the produce of agriculture to the market wherever convenient and certainly not in all cases. It may bring back some fertilisers and essential items. But certainly it will bring back most items non-essential to agriculture and the frequent trips to the urban centres make the agriculturists more interested in the urban facilities, and the easy way of making money and under estimate his own contribution to the urban economy.

(e) Extension Services are all geared to the creation of a marketable surplus and many times they are not totally relevant to the particular locality or to the region in which they operated, because they are uniform through the State. For example in the Dist. of Uttara Kannada there are 11 Taluks with four clear-cut Agronomical Geographical Regions-costal strip, the Western Slope, Central high lands and the eastern slopes. The major part of the Dist., particularly in the western slope and central highlands, has horticultural crops like areca, coconut, banana, cardamum, pepper and betole laeves, interspersed here and there by paddy and sugarcane only for family consumption. The coastal strips has both paddy, coconut and groundnut as a second crop. The eastern slopes are the main paddy surplus centres, but it is a single crop. The Extension Services provided by the Department of Agricultural Taluk wise is 1 Assistant Director, 3 Specialists, 2 Jeeps, 15-20 Agril. Assistants. The pattern is also changing. In the costal strip these Extension. Services are limited to new strains of paddy, pests and diseases control. The second crop of groundnut for which seeds are procured from Dharwad area supposed to be low in oil content and proper extension services are not available. Nearly 24 per cent of the paddy land in coastal area from Karwar

to Bhatkal is Khar lands in which extension services are totally absent. In the central highlands the Agril. Department can provide extension services only for paddy and sugarcane andin patches for the second crop. In the eastern slopes with the entire set up of the Dist. for the Talukas in both in Haliyal and Mundgod second crop viable and profitable has not been introduced. Wherever it has been improved or provided, sugarcane is cultivated, to be supplied to sugar factories in Dharwad/Belgaum Districts. The main thrust of cropping pattern in this district is horticultural, coconut and banana and other tree crops are a common feature everywhere and arecanut and subsidiary crops in the vallies and central highlands for which the Horticultural. Department has a very meagre staff-practically no extension services as such. This imbalance has not recived any attention at state level by the concerned department individually or severally and even by the Agricultural University. Providing the research base for this. Therefore the question arises as to how the extension services may bemade more realistic and meaningful emphasising the need forintegrated system of approach, programming, supplies aud services.

5. Planning at the local level insisted earlier on the farm plans through the local institution of Panchayatraj were the Panchayat, Taluk Boards and the Dist. Development Council operated. The Taluk was considered as on area for planning but unfortunately the situation that existed in the taluk was not considered as a base for planning. Planning was just programming for the various Schemes that came from the above, Departmentwise Supplies and Services provided itemwise. The S.F.D.A. and the present D.R.D.S. entrusted with the specific responsibilty of making small farmers and marginal farmers viable, failed to perceive the integrated nature of the plan base. They became the distributors of State-oriented Benefit Schemes and nothing more.

6. The technology adopted in the Agricultural Development contributing: (a) to the adoption of mechanical tools and devices in Agriculture and (b) adopting a package mix in production both in many cases had no local relevance. From Japanese Power Tillers to Pumpsets without the supporting repairing services and without enlighting of agriculturists regarding the mechanisms, it failed to evolve response even though the number of pumpsets no doubt increased because of the subsidy contents in the Schemes, and the maximum use of water was never an item of any extension ideology. Similarly rural electrification which was the basis for the pumpsets provided mainly the lights for the houses with no energy for any supporting subsidiary occupations and even that energy supply was partial and halting.

7. The strategy for Agricultural Development therefore has been partial limited to field crops extending always the Schemes from above believing perhaps the trickledown theory of "Development from above". Particularly in the case of unirrigated rainfed subsistency farming economy where the new owners—beneficiary of the land reforms predominate, there has been no impact of agricultural growth. It is a big question whether land reforms have contributed to increase in production except bridging largely the inequalities that existed in the former farming systems. Anybody can see that production as such has not increased to the desired extent except the 2nd crops supporting the first crops in the coastal strip of Uttara Kannada i.e., groundnut supporting the paddy farmer and prawn culture supporting the farmer in the costal area. Sericulture has been introduced successfully, but it has attracted the middle and the upper groups of the farmers rather than the poor because the technology of sericulture has not been within the reach of the poor farmer and extension services are lacking. Moreover it has not been integrated with his main occupation of Subsistance Agriculture.

8. The question therefore arises as to how we approach the 21st Century with this set up. The one-way migration of

men, animals and goods to the urban area depleting the rural sector of its educated content the inputs has to stop or at least has to be reversed. This can be done if the undue and unnecessary emphasis on a marketing centre in an urban area is given up and processing and marketing facilities along with the supporting systems are brought back to the villages.

9. What is really needed is an approach which considers agriculture in a comprehensive sense. For our region especially, I can very well say that only an integrated approach which include Agriculture, Horticulture, Animal Husbandary and Fisheries can deliver the goods if the agriculturist is taken as a central figure to whom and by whom the whole programme is to be carried out. This may look like a tall claim but regional planning loses all its significance if it ignores the realities of the region and becomes a mechanisim for programming Centrally Directed Schemes.

10. On a Unit of land what are all the crops that can be grown supporting the agriculturist and his cattle what are the supply systems necessary for developing this Agro-forestry? What will be the research backup for several items that enter into this component of agro forestry? It is not only fodder, fuel, green leaves, timber for agricultural pursuits, it is also the breeding and feeding of animals and the small technology that would go to the help of the farmer. The non-commerical energy is the energy in the rural area. Even though rural electrification is taking place it is not giving the priority. Therefore a fresh look at the rural resource base supporting the Agricultural Systems in which the individual agriculturist plays a pridomeinent part is necessary by all the individual officers or other institutions that are supporting agriculture from above and even though it might be a painful process, a reversal to the Bottom-up, that is from the Grass Root approach has to be made the basis for Agricultural Strategy in the 21st Century.

AGRARIAN STRUCTURE AND STRATEGIES FOR AGRICULTURAL DEVELOPMENT FOR THE 21ST CENTURY

Y. M. L. SHARMA

1. General

1.1 Karnataka State is endowed with both rainfalls South West and North East. 60 per cent land area receives a rainfall of less than 40". The forest vegetation is diverse ranging from the tropical evergreen forests on the Western Ghats to the arid and desert like tracts like Bilgi in the North east. The land use pattern consequently is varied. The normal land use pattern is raising paddy/sugarcane in the irrigated areas and ragi, jowar, pulses etc., in the dry farming areas.

1.2 The uncertainty of rains in recent years, higher costs of inputs, mounting labour costs, costs on pests and diseases, want of timely technical advice and need for improvement of this economy, have all compelled the farmers to shift to fields other than stereotyped agriculture. The shift is towards a less labour intensive and high yielding technology.

2. Land use

A proper land use policy is lacking. It is also difficult to promulgate one. We can only see that all land should be put under some crop or other and not left fallow. There is, neither, any land capability maps. It would be advantageous to put dry farming lands of Chitradurga, Bellary and other dry districts under evergreen and deciduous tree crops which would contribute towards a better yield and ecosystem. There is no protection against wind and water erosion. Contour bunding on an extensive scale has not been possible due to small holdings which also prevents adopting collective

farming techniques. Land ceiling and fragmentation of land are two other factors preventing scientific cultivation patterns.

3. Irrigation and use of water resources

Irrigation has not been very effective. There is more wastage of water and the water regime has not been satisfactory. There could be better water management.

Use of water

The best manner of land and water use in the different agroclimatic regions should be done on top priority by having demonstration plots and intensive extension work. Farmers should be shown the optimum use of water for each type of crop. The water rate should be commensurate with the type of crop raised.

4. Command Area Development

The management of the command area could be improved. There appears to be no guidelines for the development of command area. Funds are lacking and disinterested ones in this are put incharge of such development work. Unless there is an integrated scheme of development of agriculture, forestry and horticulture and fisheries in each command area they continue to pose problems.

5. Migration from rural to urban areas

There is migration of youth from rural to urban areas, leaving the old and infirm villagers who are unable to work. The result is that the lands are not cultivated to their optimum capacity. This can only be overcome by creating more employment opportunities in the rural area. Setting up rural and cottage industies, providing the farmer a reasonable price for his produce, bettering housing and water supply, sanitation and lighting and recreation. Afforestation/soil conservation/ improving water supply, desilting of tanks etc., provide jobs near at hand and create other amenities. If our policies

and programmes are not changed by the turn of the century, there would be suffocation in urdan areas and agricultural land will not have people to till them and economy will be jeopardised.

6. To prevent this exodus and better development of rural areas the under mentioned strategies deserve consideration.

6.1 Land use survey

A quick and proper land use survey should be carriedout. All lands suitable for agricultural/horticulture sericulture should be identified. Lands unsuitable to the above three categories and under private ownership should be earmarked for agroforestry.

6.2 Transfer of land to Forest Department

No more forest land should be released to agriculture in the state as the ecological balance is precarious. All vacant lands other than those actually under the plough and incharge of Government - irrespective of the departments should be transferred to the charge of Forest Department to bring such of them under suitable tree crops. Encroachments in the forest areas have to be evicted and not regularised.

6.3 Water regime

Attempts should be made to grow 3 crops under command areas and irrigated areas or at least 2 irrigated and one dry crop which will compensate the low yield from other areas by proper water regime and inputs.

6.4 Multiple and multistoreyed cropping

Multiple cropping in irrigated and other lands multistoreyed cropping pattern on garden lands should be tried. This would provide varied types of agricultural crops, pest control expenses would be reduced, soil would not be depleted by monoculture and result in proper utilisation of space.

6.5 Garland planting

Garland planting on the berms of all agricultural lands - irrigated and rainfed sould be made compulsory by law, as this is the only approach to produce small timber, fuel wood, fodder and fertilizer nearer the home of the farmers.

6.6 Farm wood lots

Farmers owning over 10 hectares of farming land should grow on one tenth or even more if possible of the area, fuel, small timber, usufruchts, fodder, fertilizer yielding trees and bamboo as farm wood lots.

6.7 Social Forestry by cluster of villages

Implementation of social forestry schemes in all its aspects should be done selecting a cluster of villages as a whole. UAS may perhaps initiate an experiment.

6.8 Agro forestry

Agroforestry is an important tool to reclaim encroached or unauthorisedly cultivated lands and lands under shifting cultivation as in North West of Karnataka. Though there has been lot of talk on this aspect precious little has been done in the field. This approach should be given a fair trial, especially by UAS taking up demonstration areas in areas like Kankumbi near Belgaum, other encroached and unauthorisedly cultivated lands.

6.9 Fair price

The farmer should be assured of reasonable return for his product failing which the entire agricultural economy would be demoralised

6.10 Research goal

Forest areas having dwindled, fuel wood is of primordial concern in the rural sector. Agricultural lands cannot there-

fore, be increased in the country. Time bound research with dedicated involvement should aim at maximum production per hectare in different agro-climatic regions through intensive and profitable use of land and water, minimum inputs, rotation of crops adopting multiple and mixed cropping patterns by improvements in harvesting and indicating the extent of commercial crops to be raised etc. The ultimate aim of research should not only be the improvement of economic conditions of the poor but also the creation of small catchments of industrial raw material in the rural sector to initiate an entrepreneural capability in the farmer.

6.11 Finance

The financial institutions should change their approach and give the maximum encouragement in this developmental activity.

6.12 Extension service

The extension wing of the Agricultural Department and Universities should organise the rural people creating new production relations and selling appropriate technologies to the farmers. They should train village level workers in an integrated practical approach to agriculture, forestry, sericulture, horticulture and animal husbandry. There should be a village level worker in every village.

6.13 The management services should not feel shy of having the services of the good technical people in service or retired in the interest of the country at large.

PROSPECTS OF INDIAN AGRICULTURE-2000 A.D.

H. S. VIJAYA KUMAR, RAMACHANDRA BHAT and S. C. HIREMATH

The growth of any country depends largely upon the growth rates of population and agriculture. The latter must be higher than the former. Lest the resources will be drained out in importing food and hence the production of intermediate products and capital formation will suffer. The planning commission estimates the rate of growth of population to fall to 2 per cent p. a. by 1990. The growth in the agricultural sector is expected to be 4 per cent during the seventh plan which looks to be ambitious considering the good year 1984-85 which is the basis for the VII plan.

The projections of gross cropped area (GCA) for 2000 AD show that about 194 M. ha of GCA will be available at the turn of this century. This is subject to the extension of cultivation to the untapped cultivable land, increase in the irrigation potential and non-encroachment of agricultural lands for roads, house building etc. Proper action is needed on the part of all concerned to bring in as much additional area under cultivation as possible so as to help the agricultural sector contribute to production as desired.

Hand in hand is the case of gross irigated area (GIA) whose projection shows an availability of 110.57 M. ha by 2000 AD. It should be noted here that a maximum of about 114 M. ha. rrigation potential can be created in India. Also, the achievements of creating additional irrigation potential in the past are not very enouraging. Hence, it may be assumed that about 100 M.ha of GIA will be available at the end of this century. However, all efforts must be geared up to utilise the created potential to the fullest extent, thereby avoiding any underutilization. Necessary infrastructural facilities need to be created

for the same and proper policies—both incentives and disincentives must be balanced to achieve the cropping pattern needed to meet the future challenges of agricultural sector. It may be noted here that the land utilization must undergo a thorough change by diverting the area under irrigation to commercial crops like sugarcane, cotton and groundnut, so as to increase the production of these crops. Estimates of consumption of chemical fertilizers for the year 2000 show about 23 M. tonnes of N, 8 M. tonnes of P and 3.3 M. tonnes of K will be used in the country. But the capacity to produce N and P (targeted) by 1994-95 stands at 9.7 M. tonnes and 3.6 M. tonnes, respectively. Further, the average capacity utilization of the fertilizer plants in our country stands at 65 per cent. Hence, there is an urgent need to step-up the capacity utilization to the maximum extent. Since, all the potassic fertilizer have to be imported there is likely to be a drain on our meagre foreign exchange reserves. These situations warrant an urgent need to step up research activities in the use of organic manure, rhizobium culture and vermification on a large scale.

On the production front, the output of foodgrains are likely to touch 220 M. tonnes by the turn of this century. Though the situation is likely to be helpful in maintaining self-sufficienty, caution must be taken against complacency. As mentioned earlier. there is a wide scope for increasing production through increased productivity in minor cereals, millets and pulses where extension of dryland farming technology has relevance.

With the help of the estimates growth rates in commercial crops, the production of sugarcane, cotton and groundnut are estimated to be 1899.39 M. tonnes, 73.53 M. bales and 35.83 M. tonnes, respectively by 2000 AD. But these are possible with a leaf in area under these crops and productivities, both of which in the present circumstances are not possible to materialise. However proper planning of the cropping patterns

combined with increased productivities in foodgrains will help extension of area under these crops and will be helpful in increasing their production to a large extent.

Conclusions :

The input use in Indian agriculture has shown a steady increase over the last two decades. Because of a limitation in extending the area under cultivation, intensification is called for to achieve increased supply of outputs. Because of limited capacity to produce inorganic fertilizers, emphasis should be laid on use of organic sources which are abundantly available. Future research must concentrate on dry land farming techniques so as to release the irrigated area for cultivating other important crops like sugarcane, cotton and groundnut.

It is feasible to plan in terms of agricultural growth rate of about 4 per cent per annum provided agricultural programmes are funded adequately. There being no alternative to the effective use of fertilizer and irrigation, substantial resources will have to be devoted to agricultural infrastructure in the years to come. Expansion of production, expansion of facilities for research and farm credit system require an expanded coverage. All this means agricultural growth cannot be brought about cheaply. Considering the acute scarcity of resources and a sharp decline in the external assistance difficult question will arise in determining the priorities in resource use.

AUTOMATED TECHNIQUES FOR QUALITY CONTROL OF FISH AND FISHERY PRODUCTS

I. KARUNASAGAR

Since fishery products like shrimps have to compete in the international market, it would be inevitable that the processors use rapid and current technology for quality control. Limulus lysate test will be of application in rapid assessment of bacterial load of fish. The Indian Institute of Chemical Biology, Calcutta has already developed a test kit based on amoebocyte lysate from Indian horse shoe crab and a project has been taken up in the College of Fisheries, Mangalore to study the applicability of this kit for fishery products. Another technique that holds promise is impediometry. Already an instrument "Bactometer" based on this technology has appeared in the market and there are reports of using this instrument in estimating microbial numbers, antibiotic residues in meat in advanced countries.

Rapid techniques based on antibodies produced by hybridoma technology might be applicable for detection of pathogens in fishery products like *Salmonella, Vibriocholerae* and also of toxins like paralytic and diarrhetic shellfish toxins.

Indentification of bacteria isolated from fishery products might be made easy by the introduction of test systems like API system or Patho Tech system which are largely applicable to bacteria of medical importance.

X PROGRAMME

3-12-1985

Morning

9.30 to 10.30	Registration of participants at the Agricultural College Auditorium, Hebbal.
10-30 to 11-30	Inaugural Function at the Agricultural College Auditorium, Hebbal.
11-30 to 12-00	Tea break
12-00 to 1-00	*Key Note Address :* Dr. G. V. K. Rao, IAS (Retd) Former Chief Secretary to Government of Karnataka, Former Member of Planning Commission. *Chairman :* Shri D. Chalia Vice-Chancellor Assam Agricultural University.

Afternoon

1-00 to 2-00	Lunch break
2-00 to 3-15	**Session-I "Cropping Systems"** *Chairman :* Shri K. Paparao Progressive Farmer, Karnataka. *Leader :* Dr. K. R. Kulkarni, Associate Director of Research, UAS.

Rapporteurs :

Dr. D. N. Nagaraj
Dr. K. T. Krishnegowda.

3-15 to 3-30 Tea break

3-30 to 4-45 **Session-II : "Farming Systems"**

Chairman :

Shri Dhirendra Singh, IAS
Secretary to Government of Karnataka
Agriculture and Animal Husbandry Dept.

Leader :

Dr. G. V. Havanagi, Professor and Head.
Department of Agronomy, UAS.

Rapporteurs :

Dr. A. S. Kumaraswamy
Dr. H. V. Nanjappa

6-00 to 7-30 Entertainment programme at the Auditorium of the Agricultural College, Hebbal

4-12-1985

Morning

9-00 to 10-15 **Session-III : "Settlement Policy"**

Chairman :

Shri M. V. Rajashekaran
Executive Trustee and Co-ordinator, Asian Institute for Rural Development, Bangalore.

Leader :

Dr. S. Bislaiah, Prof. of Economics, UAS

Rapporteurs :

Shri S. Nagaraju
Smt M. Rani

10-15 to 10-30 Tea break

10-30 to 11-45 **Session-IV : "Social Mobilization"**

Chairman :

Mr. Aziz-Ul-Haq, Former Director, Bangla Desh Academy for Rural Development, Former Director, Centre on Integrated Rural Development for Asia and Pacific.

Leader :

Prof. Srinivasamurthy, J. Professor of Agricultural Extension (Dev. Edn.), UAS

Rapporteurs :

Shri Narasimha, N.
Shri Nijalingappa, B.

11-45 to 1-00 **Session-V : "Land and Water Use Policy"**

Chairman :

Shri Balekundri, S. G.
Chief Engineer (Retd), Govt. of Karnataka

Leader :

Dr. Hegde, B. R. Chief Scientist
Dry Land Agril. Project, UAS

Rapporteurs :

Prof. Itnal, C. J.
Dr. Srinivasamurthy, C. A.

Afternon

1-00 to 2-00 Lunch break

2-00 to 3-15 **Session-VI : "Institutional Planning"**

Chairman :

Prof. Khusro, A. M.
Chairman, National Institute of Public Finance and Policy, New Delhi.
Former Member of Planning Commission

Leader :

Dr. Sethu Rao, M. K. Professor and Head, Division of Education and extension UAS

Rapporteurs :

Shri Rame Gowda, B. L.
Shri Nagaraj, N.

3-15 to 3-30 Tea break

3-30 to 4-45 **Session-VII : "Research and Development Planning"**

Chairman :

Dr. Nanjundappa, D. M.
Secretary to Govt. of Karnataka, Dept. of Planning and Institutional Finance.

Leader :

Dr. Krishnamurthy, K.
Director of Research, UAS.

Rapporteurs :

Dr. Singlachar, M. A.
Shri Rangamannar, D.

5-12-1985

Morning

9-00 to 10-15 **Session-VIII : "Marketing Infrastructure"**

Chairman :

Dr. Patil, M. B.
Principal, Cooperative Training College Trivandrum, Kerala

Leader :

Dr, Chengappa, P. G. Professor of Agricultural Marketing, UAS.

Rapporteurs :

Shri Lalith Achuth
Shri Karamathulla, N.

10-15 to 10-30 Tea break

10-30 to 11-45 **Session-IX : "Mobilization of Financial Resources"**

Chairman :

Prof. Khusro, A. M.
Chairman, National Institute of Public Finance and Policy, New Delhi
Former Member of Planning Commission.

Leader :

Dr. Ramanna, R.
Director of Instruction (Agri), UAS

Rapporteurs :

Shri Nanjundegowda, G.
Dr. Chandrakanth, M. G.

11-45 to 1-00 **Session-X : "Management Services"**

Chairman :

Shri Balasubramanyan, V. IAS
Secretary, Central Silk Board

Leader :

Dr. Jalihal, K. A.
Director of Extension, UAS

Rapporteurs :

Dr. Katteppa, Y.
Dr. Goudar, L. V. H.

Afternoon

1-00 to 2-00	Lunch break
2-30 to 4-30	**Plenary Session**
	Chairman :
	Shri P. R. Nayak IAS Development Commissioner Government of Karnataka
	Rapporteurs :
	Dr. Y. Katteppa Dr. L. V H. Goudar Shri D. V. Nagaraj
4-30 to 4-45	Tea

(*Note :* After Inaugural function, all other sessions will be held in the Seminar Hall of the Veterinary College, Hebbal, Bangalore-24)

XI CONTRIBUTORS OF PAPERS

University of Agricultural Sciences, Bangalore

1. Dr. Achar, H. P.
   Professor and Head, Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dharwad-580 005

2. Mr. Adavani, M. R.
   Associate Professor, Department of Statistics, College of Agriculture, Dharwad-580 005

3. Dr. Anilkumar, T. B.
   Department of Plant Pathology,
   Bangalore 560 065

4. Mr. Arunkumar, K. S.
   Assistant Professor, Department of Agricultural, Economics, College of Agriculture, GKVK,
   Bangalore-560 065

5. Dr. Balakrishna Rao, K.
   Regional Associate Director, NARP, Regional Research Station, Bramhawar-576 213

6. Dr. Basavaiah, P.
   Geneticist, All India Coordinated Project on Buffaloe, RRS, Dharwad

7. Mr. Basavaraju, N.
   Farm Superintendent (Fish), Fishery Research Station, Hessaraghatta, Bangalore

8. Mr. Benakappa, S.
Assistant Farm Management Specialist, Extension Education Unit, College of Fisheries, Mangalore–575 002

9. Mrs. Bharathi, M.
Department of Sociology, GKVK, Bangalore-560 065

10. Dr. (Mrs.) Bhavani Belavady,
Dept. of Rural Home Science, UAS, Hebbal Bangalore-560 024

11. Dr. Bhaskar, V.
Head of the Department of Farm Forestry, GKVK, Bangalore-560 065

12. Dr. Bisalaiah, S.
Professor of Economics, UAS, GKVK, Bangalore-560 065

13. Dr. Bojappa, K. M.
Professor and Head, Division of Horticulture, GKVK, Bangalore-560 065

14. Dr. Bomme Gowda, A.
Senior Seed Research Officer, National Seed Project, GKVK, Bangalore-560 065

15. Dr. Chandrakanth, M. G.
Associate Professor of Agricultural Economics, UAS, Bangalore-560 024

16. Mr. Chandrashekar, H.
Department of Statistics, Agricultural College, Dharwad-580 005

17. Mr. Chandrashekara Buggi,
Associate Professor and Head, Dept. of Sociology GKVK, Bangalore–560 065

18. Dr. Channegowda, M. B.
Professor, Department of Agricultural Extension, College of Agriculture, Dharwad-580 005

19. Dr. Chengappa, P. G.
Professor, Dept. of Agricultural, Marketing & Cooperation, College of Agriculture, GKVK, Bangalore-560 065

20. Dr. Chikkasubbanna, V.
Instructor, Division of Horticulture, GKVK, Bangalore-560 065

21. Mr. Chinnappa Reddy, B. V.
Assistant Professor, Dept. of Agricultural Economics, GKVK, Bangalore-560 065

22. Dr. Das, T. K.
Professor of Animal Nutrition, Veterinary College, Hebbal, Bangalore-560 024

23. Dr. Devaraj, K. V.
Chief Scientific Officer (Inland Fisheries), Veterinary College, Hebbal, Bangalore-560 024

24. Dr. Dixit, L. A.
Professor, Dept. of Agronomy, College of Agriculture, Dharwad-580 005

25. Mr. Farooqui, A. A.
Assoc. Professor, Division of Horticultre, GKVK, Bangalore-560 065

26. Dr. Gopalakrishna Pillai, K.
Project Coordinator (Agronomy), AICARP, GKVK, Bangalore-560 065

27. Dr. Goud, J.V
Professor and Head, Department of Agricultural Botany, Agricultural College, Dharwad-580005

28. (a) Mr. Govinda Gowda, S.
Assistant Professor(Sociology), GKVK
Bangalore-560 0024

29. Dr. Gupta, T. R. C
Assistant Professor of Limnology, College of Fisheries, Mangalore-575 002

30. Dr. Hadimani, A. S.
Regional Assoc. Director, RRS. Raichur

31. Mr. Hariharan, V.
Assistant Professor of Oceanography, College of Fisheries, Mangalore-575 002

32. Dr. Havanagi, G. V.
Professor and Head, Dept. of Agronomy, College of Agriculture, GKVK, Bangalore-560 065

33 Dr. Hanumanthappa, H. S.
Training Coordinator, Staff Training Unit, Hebbal, Bangalore-560 024

34. Dr. Hegde, B. P.
Assoc. Professor, Dept. of Animal Geneticist and Breeding, Veterinary College, Hebbal, Bangalore-560 024

35. Dr. Hegde, B. R.
Chief Scientist, Dry Farming Scheme and Operational Research Project on Dry Farming, GKVK, Bangalore-560 065

36. Mr. Hiremath, S.C.
Department of Agricultural Finance, Agricultural College, Darawad-580 005

37. Mrs. Hemalatha, M. Patil
Assoc. Professor, Dept. of Agril. Marketing & Co-operation, Agril. College, GKVK, Bangalore-65

38. Dr. Hosmani, M. M.
Senior Agronomist, Main Centre for Cropping Systems Research, ARS., Honnavile, Shimoga

39. Mr. Itnal, C. J.
Professor of Agronomy, ORP, Kabbanala Watershed Project, GKVK, Bangalore-560 065

40. Dr. Jalihal, K. A.
Director of Extension, Hebbal, Bangalore-560 024

41. Dr. Jayaramaiah, K. M.
Editor, Communication Centre, UAS, Hebbal, Bangalore-560 024

42. Mr. Joseph K. Mannisery
Assistant Professor of Fish Culture, College of Fisheries, Mangalore-575 002

43. Mr. Kachapur, M. D.
Project on Water Management, Agricultural College, Dharwad-580 005

44. Mr. Kaleemulla Sharief
Former M. Sc., (Agri.) student in Soil Science UAS, Hebbal, Bangalore-560 024

45. Dr. Karunasagar, I.
Assoc. Professor, Dept. of Fishery Microbiology, College of Fisheries, Mangalore-575 002

46. Mr. Katti, R. J.
Department of Limnology, Fisheries College, Mangalore-575 002

47. Mr. Kavalappa, B. N.
Soil Scientist, Co-ordinated Scheme on Longterm Fertilizer Experiments, Dept. of Soil Science, Agril. College, GKVK, Bangalore-560 065

48. Mr. Kavi, P. S.
Assistant Meterologist, UAS, GKVK, Bangalore-560 065

49. Mr. Keshava Reddy, T. R.
Assistant Professor, Dept. of Agril. Economics, Agril. College, GKVK, Bangalore-560 065.

50. Dr. K. S. Krishna
Extension Leader, EEU, R. R. S., Mandya

51. Dr. Krishnamurthy, A. N.
Managing Director, Bangalore Animal Food Corporation, Bangalore-560 024

52. Dr. Krishna Murthy, K.
Director of Research, UAS, GKVK, Bangalore-65

53. Dr. Krishnappa, K.
Assoc. Prof., Dept. of Plant Pathology, GKVK, Bangalore-560 065

54. Dr. Kulkarni, G. N.
Prof., Dept. of Seed Technology, College of Agriculture Dharwad-580 005

55 Dr. Kulkarni, K. R.
Assoc. Director of Research (Agri.)
GKVK, Bangalore-560 065

56. Dr. Kulkarni, R. S.
Assoc Professor, Dept of Plant Breeding and Genetics, College of Agriculture, GKVK, Bangalore-560 065

57. Dr. Lalith Achoth
Assistant Professor, Dept. of Agril Economics,
GKVK, Bangalore-560 065

58 Dr Lokanath, G R.
Assoc. Professor of Poultry,
UAS, Hebbal, Bangalore-560 024

59. Dr. Mahishi, D. M.
Assoc Professor, Dept. of Agril Botany,
College of Agriculture, GKVK, Bangalore-560 065

60. Mr Mallikarjunappa, S.
AICRP on Buffaloe, Agricultural College
Dharwad-580 005

61. Mr Mandanna, P. K.
Asst Prof, Dept. of Agril. Economics
College of Agriculture, Dharwad-580 005

62. Dr. Melanta, K. R.
Assoc Prof, Division of Horticulture
GKVK, Bangalore 560 065

63. Mr. Mohankumar, G. N.
Assistant Professor, Division of Horticulture,
GKVK, Bangalore 560 065

64. Dr. Mourya, N. L.
Principal, Agril Engineering Institute,
Raichur-584 101

65 Dr. Muddappagowda, P.
Prof, of Horticulture (Olericulture) Division of
Horticulture, UAS, GKVK, Bangalore-560 065

66. Mr. Mune Gowda, M. K.
Agronomist, Fodder Scheme,
KDDC. Project MRS, Hebbal,
Bangalore-560 024

67. Mr. Nadaf, K.
Department of Agriculture Botany,
Agricultural College, Dharwad-580 005

68. Mr Nagaraj, N.
Assistant Professor, Dept. of Agril. Economics
College of Agricultural, GKVK, Bangalore-560 065

69. Mr Nagaraja, S.
Dept of Economics, GKVK, Bangalore-560 065

70. Dr. Naidu, B S.
Regional Assoc. Director, NARP,
RRS, Mandya

71. Dr. Nalwadi, U.G.
Professor of Horticulture College of Agriculture
Dharwad-580 005

72. Dr Nanja Reddy, C
Professor of Agril. Economics
UAS, GKVK, Bangalore-560 065

73. Mr. Nanjunda Gowda, G.
Assoc. Prof. of Agril. Finance
Agril, College, GKVK, Bangalore-560 065

74. Mr. Naravani, N. B.
Head Farm Management Section
AEI Raichur

75. Mr. Nisar Ahmed
Assistant Professor (Soil & Water Management)
Agril. Engineering Institute, Raichur-584 101

76. Dr. Panchal, Y. C.
Prof. of Crop Physiology, College of Agriculture, Dharwad-580 005

77. Dr. Patil, C. V.
Soil Physicist, Coordinated, Project on Water Management, Belawatagi Farm, Navalgund Taluk Dharwad Dist.

78. Dr. Patil. S. V.
Vice-Chancellor, UAS, GKVK, Bangalore-560 065

79. Dr. Prabhakar, A. S.
Chief Scientist, Coordinated Project on Water Management, Belawatagi Farm, Navalgund Taluk Dharwad Dist.

80. Dr. Prabhakar, Setty, T. K.
Agronomist, All India Co-ordinated Agronomic Research Project (ICAR), GKVK, Bangalore-560 065

81. Dr. Prakash, K. S.
Junior Rice Breeder
All India Co-ordinated Rice Improvement Project
Agril. Research Station, Siruguppa-583 121

82. Mr. Prakash, T N.
Instructor, Dept. of Agril. Economics
College of Agriculture, GKVK, Bangalore-560 065

83. Mr. Purushotham, S.
Jr. Agronomist, UAS, Bangalore-560 024

84. Dr. Rai, A. V.
Director of Instruction, Veterinary College, Hebbal, Bangalore-560 024.

85. Dr. Rai, P. V.
Professor of Agricultural Microbiology
G. K. V. K., Bangalore-560 065.

86. Mr. Rajanna, A.
Deputy Director of Agriculture,
Karnataka State Department of Agriculture

87. Mr. Ramachandra Bhat
Assistant Professor, Department of Agril. Marketing and Cooperation, College of Agriculture,
Dharwad-580 005

88 Dr. Ramanna, R.
Director of Instruction (Agri) I/c. College of Agriculture, GKVK, Bangalore-560 065.

89. Dr. Ramappa, B. S.
Professor of Poultry, UAS, Hebbal, Bangalore-24.

90 Mr. Rame Gowda
Assistant Seed Research Officer,
National Seed Project, GKVK, Bangalore-560 065.

91. Miss Rani, M.
Department of Economics, GKVK, Bangalore-65.

92. Dr. Rebello, N.S.P.
Coordinator, Project Planning and Monitoring Cell,
G.K.V.K, Bangalore-560 065.

93. Dr. Salian, P. K.
Head of Division of Fishery Science
College of Fisheries, Mangalore-575 002.

94. Dr. Satyan, B.A.
Associate Professor, Department of Agricultural Botany
College of Agriculture, G.K.V.K., Bangalore-560 065

95. Dr. Sethu Rao, M.K.
Professor and Head, Department of Agricultural Extension, College of Agriculture, GKVK,
Bangalore-560065

96. Dr. Shanbhogue, S. L.
Professor of Fishery Biology,
College of Fisheries, Mangalore-575 002

97. Mr. Shankar, M. A.
Assistant Professor of Sericulture (Agronomy)
G.K.V.K. Bangalore-560 065

98. Mr. Sarathchandra, H. C.
Jr. Entomologist, AICRP (Millets), GKVK,
Bangalore-560 065

99. Mr. Sharma, K.M.S.
Junior Statistician, Main Centre for Cropping
Systems Research, A.R.S., Honnavile, Shimoga.

100. Mrs. Shanthamma, N.S.
Assistant Professor, Department of Psychology,
G.K.V.K., Bangalore-560 065

101. Mr. Shantharam Bengre
Assistant Professor of Fish Culture
College of Fisheries, Mangalore-575 002

102. Dr. Sheshadri, S.J.
Professor of Veterinary Pathology,
Veterinary College, Hebbal, Bangalore-560 024

103. Mrs. Sheela, K.
Assistant Professor, Department of Rural Home
Sciences, U.A.S., Hebbal, Bangalore-560 024

104. Dr. Setty, K.G.H.
Professor, Department of Plant Pathology
College of Agriculture, GKVK, Bangalore-560 065

105. Dr. Shivashankar, G
Professor, Department of Plant Breeding and Genetics
College of Agriculture, GKVK, Bangalore-560 065

106. Dr. Shivashankar, K.
Professor of Crop Production
College of Agriculture, GKVK, Bangalore-560 065

107. Mr. Shivananda
Department of Agricultural Economics
Agricultural College, Bangalore

108. Dr. Siddaramappa, R.
Professor, Department of Soil Science and Agril. Chemistry, College of Agriculture, GKVK, Bangalore-560 065

109. Dr. Singlachar, M.A.
Regional Associate Director, NARP,
Agricultural Research Station, Navile

110. Mr. Somashekar, H.
Instructor, Department of Agricultural Economics
Agril. College, GKVK, Bangalore-560 065

111. Dr. Somashekarappa, G.
Assistant Professor (Agril. Extension)
Agricultural College, Bangalore

112. Mr. Srinivasa, R. N.
Department of Veterinary Pathology
Veterinary College, Hebbal, Bangalore-560 024

113. Dr. Srinivasamurthy, C.A.
Assistant Professor, Department of Soil Science and Agricultural Chemistry, College of Agriculture, Hebbal, Bangalore-560 024

114. Srinivasamurthy, J.
Professor (Development Education),
Department of Agril Extension, Agriculture College
G.K.V.K., Bangalore-560065

115. Dr. Sudarsan Rao, A N.
Associate Professor, Department of Plant Pathology
College of Agriculture, GKVK, Bangalore-560 065

116. Mr. Swami Rao, N.
Assistant Professor of Farm Forestry,
GKVK, Bangalore-560 065

117. Miss Tejasvini
Research Associate,
U.A.S , Hebbal, Bangalore-560 024

118. Dr. Thimmaraju, K.R.
Associate Professor of Horticulture, GKVK,
Bangalore-560 065

119 Dr. Vaidehi, M. P.
Associate Professor, Department of Rural Home
Economics, Hebbal, Bangalore-560 024

120. Dr. Varghese, T. J.
Professor of Fish Culture, College of Fisheries,
Mangalore-575 002

121. Dr. Vasuki, N.
Associate Professor, Department of Soil Science and
Agricultural Chemistry, College of Agriculture,
Dharwad-580 005

122. Dr. Veerabhadraiah, V.
Regional Coordinator, National Demonstration Scheme, Directorate of Extension, Hebbal, Bangalore-24.

123. Dr. Venkataram, J. V.
Professor of Agricultural Finance and Cooperation, College of Agriculture, G.K.V.K., Bangalore-560065.

124. Dr. Venkatesh Reddy, T.
Associate Professor, Division of Horticulture, G.K.V.K.
Bangalore-560 065.

125. Dr. Vijayakumar, H. S.
Associate Professor, Department of Agril. Marketing and Cooperation, Agricultural College, Dharwad.

Institute for Social & Economic Change

1. Dr. Satyapriya, V. S.
Associate Professor, ADRT Unit, Institute for Social and Economic Change, Bangalore-560 072

2. Mr. Deshpande, R. S.
Assistant Professor, ISEC, Bangalore-560 072

3. Mr. Chandrashekar, H. ISEC Bangalore-560 072

4. Mr. Nihan, K. N. ISEC, Bangalore 560 072

5. Dr. Prahladachar, M.
Associate Professor, Rural Economics Unit, ISEC, Bangalore-560 072.

National Bureau of Soil Survey & Land Use Policy Government of India, Hebbal

1. Dr. Nagabhushana, H. R.
Head, National Bureau of Soil Survey and Land Use Planning, Regional Centre, Hebbal, Bangalore-24.

2. Mr. Reddy, R. S.
Scientist-SI, NBSS & LUP, Hebbal, Bangalore-24

Institute for Command Area Studies

1. Dr. Narayan, B. K.
   Director, Institute for Command Area Studies & Irrigation Management

Department of Agriculture

1. Mr. Jothi, M.
   Additional Director of Agriculture (Soil Conservation), Directorate of Agriculture, Seshadri Road, Bangalore-560 009

Indian Institute of Management

1. Dr. Gopalaswamy, T. P.
   Professor, Centre for Agriculture and Rural Development, IIM, Bangalore-560 076.

National Dairy Research Institute, Bangalore

1. Dr. Sinha, M. N.
   Incharge Dairy Section, NDRI, Adugodi, Bangalore-30
2. Dr. Sampath, S. R.
   Head, NDRI, Adugodi, Bangalore-560 030
3. Dr. Rai, S. D. Zonal Coordinator (LLP), NDRI, Adugodi, Bangalore-560 030
4. Mr. Dhanakumar, V. G.
   Programme Officer-S_1, Lab to Land Programme, NDRI Campus, Adugodi, Bangalore-560 030
5. Mr. Ramamurthy, R. S.
   Programme Officer-SI, LLP, NDRI, Bangalore-30

Karnataka Milk Federation

1. Dr. Chennegowda, H. Director (AH),
   Karnataka Milk Federation, Poornima Building, J. C. Road, Bangalore-560 027

2. Dr. Krishna, S. P. Officer-in-charge, KMF Diagnostic Laboratory, Bangalore-560 029

3. Dr. Sundermurthy, V. S. Manager (P & I), Bangalore Cooperative Milk Producers Union Ltd., Bangalore-560 029

Foreign delegates

1. Mr. Aziz-Ul-Haq
Former Director, Bangladesh Academy for Rural Development, Former Director, Centre on Integrated Rural Development for Asia & Pacific.

2. Dr. Scarlet Epstein, T.(not attended, but contributed a paper) Social Assessment Consultant, West Sussex.

Progressive Farmers

1. Mr. Monnnappa, K. M. President, Kodagu District Krishi Samaj.

2. Mr. Kadekodi, A. P
President, Uttara Kannada District Krishik Samaj.

3 Mr. D. R. Prafullachandra,
Progressive Farmer, Shimoga

4. Mr. Revanna, R. P.
Advocate and President, Mysore Distrtict Krishik Samaj, Mysore.

5. Mr. Hiregouder, V. S. Progressive farmer and Ex-MLC Hulkoti, Dharwad Dist.

Others

1. Dr. Gopala Rao, H. S.
Director, Institute of Development Studies
University of Mysore, Mysore

2. Prof. Venkata Rao, B. V.
Former Editor, UAS, Hebbal, Bangalore-560 0024

3. Mr. Rannoray, S. R. Agricultural Officer, PRD & PD
The Vysya Bank Ltd , Administrative Office,
St. Marks Road, Bangalore-560 001

4. Prof. Sharma, Y. M. L.
International Forestry Consultant & Secretary, Indian Institute of Agricultural Technologists, Bangalore

5. Mr. Raghotham Reddy, J.
Former V. C., APAU, Hyderabad.

6. Miss Maheswari, A.
Institute of Development Studies, Mysore

Assam Agricultural University

1. Dr. Gogoi, H. N.
Associate Director of Extension Education, Assam Agricultural, Jorhat University-785 013 (Assam)

Kerala Agricultural University

1. Dr. Bhaskaran, C.
Assistant Professor of Agricultural Extension
Directorate of Extension, Kerala Agricultural University, Mannuthy, Trichur-680 651.

2. Dr. Mohandas, M.
Associate Professor of Economics, College of Cooperation and Banking, Kerala Agricultural University, Mannuthy, Trichur-680 651

3. Dr. Prasad, R. M.
Assistant Professor (Agril. Extension)
College of Agriculture, Kerala Agricultural University, Vellayani-695 522

4. Dr. Patil, M. B.
Principal, Cooperative Training College
Trivandrum.

XII. LIST OF PARTICIPANTS

I. International Expert in the field of Agricultural Development

1. Mr. Aziz-ul-Haq
   Former Director, Bangladesh Academy for Rural Development and Former Director, Centre on Integrated Rural Development for Asia and Pacific, 30, A, Dhaka University Flats, Dhaka-2 (Bangladesh)

II. Scientists from Agricultural Universities

1. Dr. Chalia, D.
   Vice-Chancellor, Assam Agricultural University, Jorhat-785 013 (Assam)
2. Dr. Patil, S. V.
   Vice-Chancellor, University of Agricultural Sciences, Bangalore (Karnataka)
3. Dr, Narayan, R.
   Dean, University of Agricultural Sciences, Bangalore (Karnataka)
4. Dr. Jalihal, K. A.
   Director of Extension, University of Agricultural Sciences, Bangalore
5. Dr. Krishnamurthy, K.
   Director of Research, University of Agricultural Sciences, Bangalore (Karnataka)

6. Dr. Ramanna, R.
Director of Instruction (Agri.),
Agricultural College, Bangalore

7. Dr. Rai, A. V
Director of Instruction (Vety), Veterinary College,
Bangalore

8. Dr. Hegde, R. K.
Director of Instruction (Agri.), Agricultural
College, Dharwad

9. Dr. Patil, R. B.
Director of Instruction (P. G. S.)
University of Agricultural Sciences,
Dharwad Campus Karnataka

10. Prof. Shetty, H. P. C.
Director of Instruction (Fish)
Fisheries College, Mangalore

11. Dr. Gogoi, H. N.
Assoc. Director of Extension Education,
Assam Agricultural University,
Jorhat-13 (Assam)

12. Dr. Nandal, D. S.
Head, Department of Agricultural Economics,
Haryana Agricultural University,
Hissar-125 004 (Haryana)

13. Dr. Dhongade, M. P.
Head, Department of Agricultural Economics,
Mahatma Phule Krishi Vidyapeeth,
Rahuri (Maharashtra)

14. Dr. Parthasarathy, P. B.
Pro of Agricultural Economics, Andhra Pradesh
Agricultural University, Hyderabad, A. P.

15. Mr. Alagappan, R. M.
Reader, Department of Agronomy,
Annamalai University, Annamalainagar-608 002.
Tamil Nadu

16. Dr. Zeaudeen, P.
Deputy Director, Chair-in-Agricultural Economics
Annamalai University, Annamalainagar-608 002
Tamil Nadu

17. Dr. Sethurao, M. K.
Professor of Agricultural Extension,
University of Agricultural Sciences,
Bangalore

18. Mr. Srinivasamurthy, J.
Professor (Dev. Education), Agricultural College,
UAS, Bangalore

19. Dr. Venkataram, J. V.
Professor of Agricultural Finance,
University of Agricultural Sciences, GKVK
Bangalore

20. Dr. Bojappa, K. M.
Professor (Horticulture), University of
Agricultural Sciences, GKVK,
Bangalore-560 065

21. Dr. Muddappa Gowda P.
Professor (Horticulture), U A S
GKVK, Bangalore-560 065

22. Dr. Shivashankar, K.
Professor of Crop Production,
Agricultural College, University of
Agricultural Sciences, Bangalore

23. Dr Rai, P. V
Professor of Agricultural Microbiology,
University of Agricultural Sciences,
GKVK, Bangalore

24. Dr. Hanumanthappa, H. S.
Training Co-ordinator, Staff Training Unit,
University of Agricultural Sciences,
Hebbal, Bangalore

25. Dr Jayaramaiah, K. M.
Editor, Communication Centre,
University of Agricultural Sciences,
Hebbal, Bangalore

26. Dr. Bomme Gowda, A.
Professor (NSP), University of Agricultural
Sciences, GKVK, Bangalore

27. Dr. Hegde, B. R
Chief Scientist (Dry farming), University of
Agricultural Sciences, GKVK, Bangalore-560 024

28. Dr. Nanja Reddy, C.
Professor (Agril. Economics),
University of Agricultural Sciences,
GKVK, Bangalore-560 065

29. Dr. Bhavani Belwadi,
National Professor, Dept of Home Science,
Hebbal, Bangalore

30. Prof. Venkata Rao, B. V.
Editor (Retd), University of Agricultural Sciences,
Bangalore.

31. Dr. Havanagi, G. V.
Professor (Agronomy), University of Agricultural Sciences, Bangalore

32. Dr. Siddaramappa, R.
Professor (Soil Science), Agricultural College, University of Agricultural Sciences, Hebbal, Bangalore

33. Dr Chengappa, P. G.
Professor of Agricultural Marketing, University of Agricultural Sciences, GKVK, Bangalore-560 065

34. Dr. Kulkarni, K. R.
Associate Director of Research, University of Agricultural Sciences, GKVK, Bangalore-560 065

35. Dr. Rebello N. S. P.
Coodinator (PPMC), University of Agricultural Sciences, GKVK, Bangalore

36. Mr. Itnal, C. J
Professor of Operation Research Project, KNWS, University of Agricultural Sciences, GKVK, Bangalore-560 065

37. Dr. Setty, K. G. H
Professor of Plant Pathology, University of Agricultural Sciences, Hebbal, Bangalore-560 024

38. Dr. Gopalakrishna Pillai
Coordinator, A.I.C.A R.P., University of Agricultural Sciences, G. K. V K, Bangalore-560 065

39. Dr. Ramappa, B. S.
Professor of Poultry Science, University of Agricultural Sciences, Hebbal, Bangalore-24

40. Dr. Sheshadri, S J.
Professor of Veterinary Pathology, Veterinary College, University of Agricultural Sciences, Hebbal, Bangalore-560 024

41. Dr. Das T. K.
Professor of Animal Nutrition, Veterinary College, University of Agricultural Sciences, Hebbal, Bangalore-560 024

42. Dr. Devaraj K. V.
Chief Scientific Officer (Inland Fisheries), Veterinary College, University of Agricultural Sciences, Hebbal, Bangalore-560 024

43 Dr. Bisaliah S.
Professor (Economics), University of Agricultural Sciences, G. K. V. K.
Bangalore-560 065

44 Dr. Goud J. V.
Professor of Agricultural Botany, Agricultural College, Dharwad-580 005.

45. Dr. Hadimani, A S.
Regional Associate Director, Regional Reseach Station, University of Agricultural Sciences, Raichur-584 101.

46. Dr. AcharH P.
Professor of Soil Science, Agricultural College, Dharwad-580 005.

47. Dr. Hosmani, M. M.
Senior Agronomist , MCCSR, Agricultural Research Station, Honnaville, Shimoga District.

48. Dr. Channegowda, M. B.
Professor of Agricultural Extension, Agricultural College. Dharwad.

49. Dr. Kulkarni, G. N.
Professor of Seed Technology, Agricultural College, Dharwad

50. Dr. Singlachar, M. A.
Regional Associate Director, P. B. No. 126, Agricultural Research Station, Navile, Shimoga District-577 201

51. Dr. Hiremath, K. C.
Professor of Agricultural Economics, Agricultural College Dharwad-5

52. Mr. Salian, P. K.
Head, Division of Fisheries Sciences, Fisheries College Mangalore

53. Mr. Verghese, T. G.
Professor (Fish Culture), Fisheries College, Mangalore

54. Dr. Prabhakar, A. S.
Chief Scientist
Project on Water Management, Belawatgi Farm
Navalgund Taluk, Dharwad District

55. Dr. Ramachandra, K. T.
Chief Training Organiser, K.V.K., Hanumanamatti

56. Dr. Pattanshetty, H. V.
Regional Associate Director, Regional Research Station
Mudigere

57. Dr. Basavaiah, P.
Geneticist, AICRP (Buffaloe), Agricultural College
Dharwad

58. Dr. Naidu, B. S.
Regional Associate Director, Regional Research Station
Mandya

59. Dr. Kulkarni, G.N.
Zonal Co-ordinator, Water Management Scheme
Dharwad

60. Dr. Balakrishna Rao, K.
Regional Associate Director, Agricultural Research
Station, Brahmavar, Udipi Taluk

61. Dr. Mourya, N. L.
Principal, Agricultural Engineering Institute
Raichur-584 101

62. Dr. Patil, V. S.
Regional Associate Director, Regional Research Station
Bijapur

63. Dr. Panchal, Y. C.
Professor of Crop Physiology, Agricultural College
Dharwad

64. Dr. Radder, G. D.
Chief Scientist (DLAP), Agril. Research Station, Bijapur

65. Dr. Krishna, K. S.
Extension Leader, V. C. Farm, Mandya-571 405

66. Dr. Thimmaraju, K. R.
Associate Professor (Horticulture), GKVK
Bangalore-560 065

67. Dr. Karunasagar, I.
Associate Professor (Fishery Microbiology), Fisheries
College, Mangalore

68. Dr. Vijayakumar, H. S.
Assoc. Professor of Finance, Agricultural College
Dharwad-5

69. Mr. Adavani, N. R.
Associate Professor of Statistics, Agricultural College
Dharwad

70. Dr. Veerabhadraiah, V.
Regional Co-ordinator, National Demonstration Scheme
Hebbal, Bangalore

71. Dr. Venkata Reddy, T.
Assoc. Professor (Horticulture), UAS, GKVK
Bangalore-65

72. Mr. Farooqui, A. A.
Assoc. Prof. (Horticulture), GKVK, Bangalore-65

73. Mrs. Hemalatha Patil
Assoc. Professor (Agril. Marketing), UAS, GKVK,
Bangalore-65

74. Mr. Kavalappa, B. N.
Soil Scientist, Co-ordinated Scheme on Long term
Fertilizer Experiments, Department of Chemistry & Soils
Agricultural College, Hebbal, Bangalore

75. Dr. Sathyan, B. A.
Assoc. Professor of Agril. Botany, Agricultural College
Hebbal, Bangalore

76. Mr. Chandrashekar Buggi
Assoc. Professor of Sociology, UAS, GKVK, Bangalore-65

77. Dr. Mohandas, M.
Assoc. Professor of Economics, College of Co-operation
and Banking, Kerala Agril. University, Mannuthy PO.
Trichur District, Kerala

78. Mr. Kadapa, S. N.
Sr. Scientist (Cotton), Agricultural College, Dharwad

79. Dr. Muralidhar Prasad, R.
Asst. Professor, Department of Agril. Extension, College of Agriculture, Vellayani-695 522, Trivandram, Kerala

80. Dr. Bhaskaran, C.
Assistant Professor, Communication Centre, Directorate of Extension, Kerala Agricultural University, Mannuthy PO Trichur District, Kerala

81. Dr. Somashekarappa, G.
Assistant Professor, Department of Agril. Extension Agricultural College, Hebbal, Bangalore

82. Mrs. Sheela, K.
Asst. Professor (Home Science), UAS, Hebbal Bangalore-24

83. Mrs. Shanthamma, N. S.
Asst. Professor of Psychology, UAS, GKVK, Bangalore-65

84. Mr. Arunkumar, K. A.
Asst. Professor (Ag. Economics), UAS, GKVK, Bangalore-65

85. Dr. Bhaskar, V.
Asst. Professor of Farm Forestry, UAS, GKVK Bangalore-65

86. Mr. Keshavareddy T. R.
Asstistant Professor of Agril. Economics, UAS, GKVK Bangalore-65

87. Mr. Prakash, T. N.
Dept. of Agril. Economics, UAS, GKVK, Bangalore-65

88. Mr. Nataraju, M. S.
Assistant Professor (Agril. Extension), UAS, Bangalore-24

89. Mr. Somashekar, H.
Instructor, Department of Agril. Economics, UAS, GKVK, Bangalore 65

90. Mr. Sartchandra, H. C.
Asst. Entomologist, Millets Scheme, UAS, GKVK Bangalore-65

91. Mr. Shankar, M. A.
Asst. Professor, (Sericulture), UAS, GKVK, Bangalore-65

92. Mr. Kavi, P. S.
Asst. Meteorologist, UAS, GKVK, Bangalore-65

93. Mr. Chinnappa Reddy, B. V.
Asst. Prof. (Agril Economics), UAS, GKVK, Bangalore-65

94. Miss. Bharathi, M.
Department of Sociology, UAS, GKVK, Bangalore-65

95. Dr. Mahishi, D. M.
Asst. Prof. of Agril. Botany, Agril. College, Hebbal Bangalore-24

96. Mr. Nagaraj, N.
Asst. Professor of Agril. Economics, UAS, Bangalore

97. Mr. Gupta, T. R. C.
Assistant professor (Limnology), Fisheries College Mangalore

98. Mr. Joseph K. Manissery
Asst. Professor (Fish Culture) Fisheries College Mangalore

99. Dr. Prakash, K. S.
Jr. Rice Breeder, ARS, Siruguppa-583 121

100. Mr. Benkappa, S.
Asst. Farm Management Specialist, Fisheries College
Mangalore

101. Dr. Venkatasubbaiah, K
Department ot Botany, Agricultural College, Dharwad

III. Eminent Experts within the Country

1. Dr. Rao, G.V.K.
Former Chief Secretary to Govt. of Karnataka,
Former Member of Planning Commission
252, 15th Main Road, R.M. Vilas Extension
Bangalore-560 020

2. Prof. Khusro, A.M.
Ex-Member of Planning Commission
Chairman, National Institute of Public Finance and Policy
18/2, Satsang Vihar Marg, Spcl. Institutional Area,
New Delhi-67

3. Mr. Balekundri, S.G.
Chief Engineer (Rtd), Govt. of Karnataka

4. Mr. Balasubramanyam, V., I.A.S.
Secretary, Central Silk Board

5. Mr. Dhirendra Singh, I.A.S.
Secretary fo Govt. of Karnataka,
Agriculture and Animal Husbandry Department, Bangalore

IV. Representatives of the State Development Departments

Department of Agriculture, Bangalore

1. Mr. Jyothi
Addl. Director of Agriculture, Directorate of Agriculture
Seshadri Road, Bangalore-1

2. Mr. Poonacha, B.A.
   Jt. Director of Agriculture (Dev), Dept. of Agriculture, Bangalore-1

3. Mr. Deshpande, M.G.
   Jt. Director of Agriculture (CC), Dept. of Agriculture, Bangalore-1

4. Mr. Gurudevaiah, T. V.
   PAO., Bangalore District
   Janatha Bhavan, Ananda Rao Circle
   Bangalore-560 009

5. Mr. Prakash G.
   Principal Agril. Officer, Chitradurga

Department of Horticulture, Bangalore

1. Mr. Krishnappa Gowda
   Deputy Director of Horticulture, Bangalore

2. Mr. Appaiah
   Deputy Director of Horticulture, Bangalore

V. Representatives from I.C.A.R. Institutes and other Organisations

I.C.A.R Institutes

1. Dr. Rai, S. D.
   Zonal Coordinator (LLP), NDRI Campus, Adugodi
   Bangalore-30

2. Dr. Sampath, S. R.
   Head, NDRI Campus, Adugodi, Bangalore-30

3. Dr. Sinha, M. N.
   Incharge, Dairy Section, NDRI Campus, Bangalore-30

4. Mr. Nagabhushana, S.R.
Head, Regional Centre, National Bureau of Soil Survey and Land Use Planning, Hebbal, Bangalore-24

5. Mr. Reddy, R. S.
S-I, National Bureau of Soil Survey and Land Use Planning, Hebbal, Bangalore-24

6. Mr. Dhanakumar, V.G.
Programme Officer, S-I LLP (ICAR) NDRI, Bangalore

7. Mr. Ramamurthy, R.S.
Programme Officer, S-I LLP, (ICAR), NDRI Bangalore

Indian Institute of Socio-Economic Studies, Bangalore

1. Dr. Patil, N. P.
Director, Indian Institute of Socio-Economic Studies Sapthagiri Complex, Sankey Road, R. M. Guttahalli Bangalore

Institute for Socio-Economic Change, Bangalore

1. Dr. Prahaladachar, P. M.
Associate Professor, Rural Economic Unit, ISEC Nagarbhavi PO, Bangalore-72

2. Dr. Sathyapriya, V. S.
Associate Professor, Agril. Development and Rural Transformation Unit, ISEC, Nagarabhavi PO Bangalore-72

3. Mr. Deshpande, R. S.
Asst. Professor, ISEC, Nagarbhavi PO, Bangalore-72

4. Mr. Govindaraju, K. V.
Institute for Socio-Economic Change, Bangalore-72

Land Development Bank, Bangalore

1. Dr. Channabasavaiah, H. S. M.
   Agricultural Engineer, Land Development Bank,
   Bangalore

Indian Institute of Management, Bangalore

1. Prof. Ratnam, N. V.
   Indian Institute of Management, Bannerghatta Road
   Bangalore-76

Coffee Research Station, Balehonnur

1. Dr. Ramaiah, P. K.
   Director of Research, Central Coffee Res. Station
   Balehonnur-577 117, Chickmagalur Dist

Cooperative Training College, Trivandrum

1. Dr. Patil, M. B.
   Principal, Cooperative Training College, Trivandrum

Institute of Development Studies, Mysore

1. Dr. Gopal Rao, H. G.
   Director, Institute of Development Studies, Mysore

Institute of Commond Area Studies, Bangalore

1. Dr. Narayan, B. K.
   Director, Institute of Command Area Studies and
   Irrigation Management, 1382, 32nd Cross
   IV 'T' Block, Jayanagar, Bangalore-41

VI. Representatives from Financing and Input Organisations

IFFCO, Bangalore

1. Dr. Thambad, S. B.
   State Marketing Manager, IFFCO
   Bangalore-4

NABARD, Bangalore

1. Dr. Thagath, V.
   Dy. Manager, NABARD, Indian Express Building
   1, Queen's Road, P. B. No. 5324, Bangalore-1

2. Dr. Hulgur, B. F.
   Development Officer (Technical)
   NABARD. Bangalore-1

VII. Progressive Farmers, Farm Leaders and Voluntary Organisations

1. Mr. Srikant, S.
   DEED, H. D. Kote Road, Hunsur-571 105

2. Mr. Shankarikop, M. S.
   PO-ADUR, Hangal, Taluk, Dharwad Dist

3. Dr. Hiremath, S. R.
   President, FEVORD Karnataka, Jayanagar Cross
   Saptapur, Dharwad-580 008

4. Mr. Prafulla Chandra, D. R.
   Nut Merchant and Commission Agent
   APMC Yard, Shimoga-577 201

5. Mr. Venkata Ready, M. K.
   President, Dist. Farmers Forum, Kolar

6. Mr. Monnappa, K. M.
   Planter, Mutharmadi Estate,
   Murnad PO, Kodagu Dist

7. Mr. Hiregoudar, V. S.
Ex-M.L.C., Hulkoti-582 205
Gadag Taluk, Dharwad Dist

8. Mr. Kadekodi, A. P.
President, Dist. Farmers Forum
Kumta (Uttar Kannada Dist.)

9. Mr. Revanna, R. P.
PO. Ramasamudra, Chamarajanagar Taluk
Mysore Dist.

10. Mr. Paparao, K.
Progressive Farmer, C/o Thirumala Enterprises
Sindhanur, Raichur Dist.

11. Mr. Devaru, S.T.
President, Raichur Dist. Farmers Fourm, Raichur

12. Mr. Shankarareddy, G.B.
Manchenahally Estate, Bangalore North Taluk

13. Mr. Govindareddy, K.
Vice President
Karnataka Pradesh Krishik Samaj, Bangalore

14. Mr. Rajashekaran, M.V.
Executive Trustee and Coordinator, Asian Institute for Rural Development, 7. a, Ratnavilasa Road
Basavanagudi, Bangalore-560 004

15. Mr. Prithipal Singh Bajaj
P.B. Sriohara, Waho Waho, Farm Venkatala village
Yelahanka Bangalore

16. Mr. Thippannanaur, M.B.
Director, Institute for Studies on Agricultural and Rural Development, Dharwad

---